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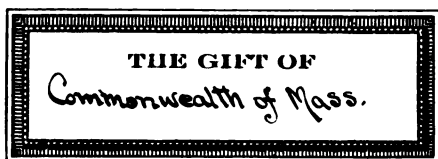
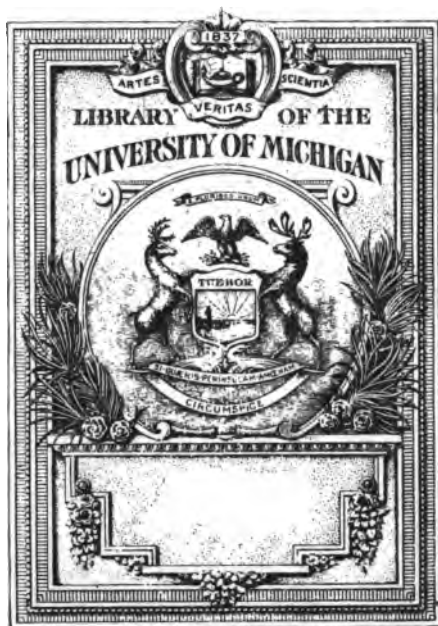
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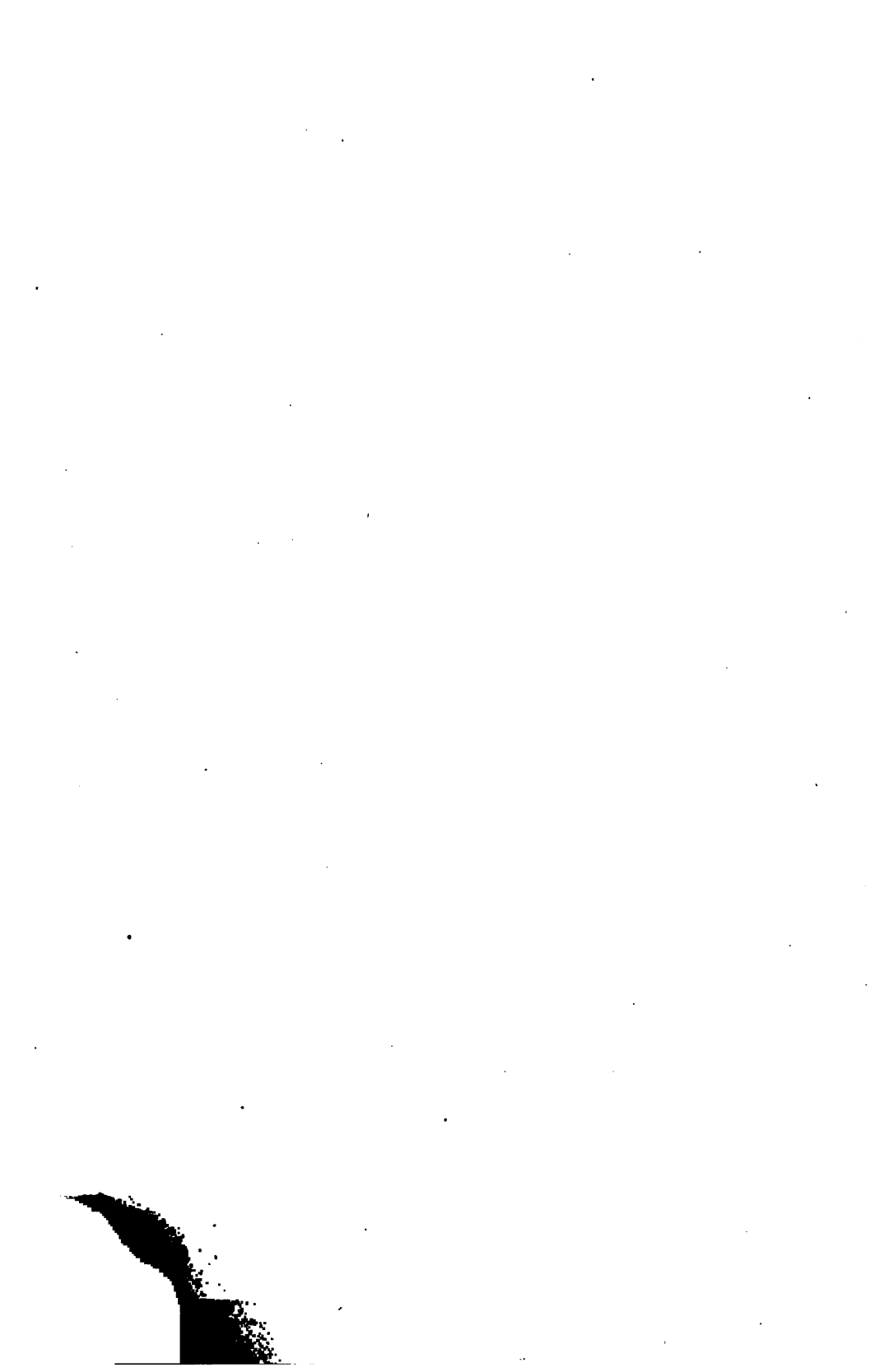
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FIFTH ANNUAL REPORT

OF THE

STATE DEPARTMENT OF HEALTH

OF

MASSACHUSETTS



BOSTON

WRIGHT & POTTER PRINTING CO., STATE PRINTERS

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FIFTH ANNUAL REPORT
OF THE
STATE DEPARTMENT OF HEALTH
OF
MASSACHUSETTS.

For the fiscal year ending Nov. 30, 1919, the State Department of Health was constituted as follows: —

Commissioner of Health, ... EUGENE R. KELLEY, M.D.

PUBLIC HEALTH COUNCIL.

EUGENE R. KELLEY, M.D., *Chairman.*

DAVID L. EDSALL, M.D., 1921. JOHN T. WHEELWRIGHT (until May, 1919).

J. E. LAMOUREUX, M.D., 1921. GEORGE C. WHIPPLE, S.B., 1920.

WM. J. GALLIVAN, M.D., 1922. WM. T. SEDGWICK, Ph.D., 1920.

WARREN C. JEWETT (appointed May, 1919), 1922.

During the year sixteen formal meetings of the Council were held, as well as many meetings of the standing and special committees of the Department. The standing committees of the Council follow: —

SANITARY ENGINEERING (INCLUDING HOUSING AND RURAL HYGIENE).

Professors Whipple and Sedgwick, Dr. Kelley and Mr. Jewett.

PREVENTIVE MEDICINE AND HYGIENE.

Drs. Edsall, Gallivan, Kelley and Lamoureux.

FOOD AND DRUGS.

Professor Sedgwick, Drs. Gallivan and Lamoureux.

FINANCE, LAW AND DEMOGRAPHY.

Dr. Kelley, Professor Whipple, Dr. Gallivan and Mr. Jewett.

THE FIFTIETH ANNIVERSARY OF ORGANIZED HEALTH WORK IN
MASSACHUSETTS.

On Sept. 15, 1869, the first meeting of the Massachusetts State Board of Health was held. It seemed most fitting that the fiftieth anniversary of that date — Sept. 15, 1919 — should receive suitable recognition. Accordingly, the Massachusetts Medical Society and the Massachusetts Association of Boards of Health co-operated with this Department in arranging exercises in commemoration of the event. A program of unusual interest had been arranged with Dr. Henry P. Walcott, former chairman of the State Board of Health, Dr. A. J. McLaughlin, the first commissioner of the present Department, and Sir Arthur Newsholme, late chief medical officer of England, as the principal speakers. However, the occurrence of the riots following the policemen's strike in the city coming just at the time of the anniversary made it necessary to cancel the meeting to the great regret of all interested in public health in this section. At a later meeting of the Public Health Council the following resolution was adopted: —

Whereas, Almost the first public act of the Massachusetts State Board of Health in 1869 was the issuance of a declaration in which occurred these memorable words: —

We believe that all citizens have an inherent right to the enjoyment of pure and uncontaminated air and water and soil; that this right shall be regarded as belonging to the whole community; and that no one shall be allowed to trespass upon it by his carelessness or his avarice or even by his ignorance;

Whereas, During the past fifty years there have been great advances in the fields of medicine, hygiene and sanitation, notably in our knowledge of the methods of transmission of communicable diseases and means of combating them, thus placing the administration of public health work upon a wider and surer foundation; be it

Resolved, That on this fiftieth anniversary of the first meeting of the State Board of Health, we, the Commissioner of Health and the Public Health Council, reiterate the above-mentioned declaration of the people's right to live under clean and wholesome conditions and commend it to the health officials of the State as a basis of sanitary administration; and be it further

Resolved, That we believe that every citizen of the State is entitled to protection from communicable disease, by the setting up of such barriers as may be most effective in preventing the spread of the causal agents of those diseases from person to person and by providing at public expense such prophylactic agencies as may enable individuals to safeguard themselves against the attacks of disease, and by conducting such diagnostic and epidemiological services as modern science deems to be necessary; and

Resolved, That we believe that human health is something more than the

absence of disease and that the people of the State should be taught to raise the standard of their own health by giving proper attention to the care of infants, the growth of children, the physique of adults, the conditions of labor, the need of proper food and sufficient sleep, the need of mental and physical recreation, and, in general, that as much care should be given to human bodies as to their environment.

In accordance with section 2, chapter 792 of the Acts of 1914, at a meeting of the Public Health Council on Jan. 13, 1920, the Commissioner of Public Health submitted to the Council a report of the activities of the Department for the fiscal year 1919, and it was voted that this report be approved and adopted as the report of the State Department of Health for the fiscal year 1919.

REPORT OF THE COMMISSIONER OF HEALTH.

EUGENE R. KELLEY, M.D.

JAN. 10, 1920.

To the Public Health Council.

GENTLEMEN: — The first year of peace has brought to this Department, in common with all departments of the Commonwealth, problems of adjustment vastly different in character but only to a degree less complex and difficult than the problems of war time. The constant disruption of personnel due to the call for military service has ceased. The post-war unrest and the economic pressure, due to the increasing discrepancy between the ever higher cost of living on the one hand and the small relative increase in compensation which the public service generally can offer, have continually operated during the year to deprive us of old experienced officers and employees, and have deterred many otherwise eager to do so from entering upon health work as a career.

Under the circumstances, I feel that a distinct though silent tribute to the Department and to the fascination of progressive health work has been paid by many members of our staff who have deliberately declined alluring offers of employment and at much more liberal terms of compensation.

Our sincere thanks are due also to the Executive Department of the Commonwealth and the General Court for their sympathetic attitude towards the underpaid public servant. Their efforts to meet the emergency, by granting at least partially adequate increases in salaries and wages, have not by any means done full justice to all or even to the majority, but was all that could be expected under the circumstances, with rising costs in every activity of the State government plus the extraordinary war obligations which were so properly assumed.

Even more important from the standpoint of the Department's work is the necessity of additional increases in salaries if the morale and general efficiency of the Department are to be kept from serious impairment.

Never have so many left the service of the Department as in the past two years, and only a portion of those leaving for military service returned even at substantially increased pay. With the exception of two or three young women employees who resigned to marry, the individual's attitude and reason assigned have always been the same, — genuine regret at severing their connection with the organization and the necessity of earning the additional money which their new position assured them.

CHANGES IN ORGANIZATION.

During the year the growing importance of public health nursing as a distinct branch of sanitary science and public health has been recognized by the creation of a special subdivision in this subject. This is expected to merely foreshadow the creation in the near future of a distinct Division of Public Health Nursing.

Mouth hygiene activities have also been inaugurated. The Commonwealth is directly indebted to the public spirit of its dental profession in general and especially to Dr. Edwin Kent, the supervisor of mouth hygiene, that such a needed advance step was consummated at the present time. No one who has made even a cursory investigation into the needs of the State in mouth hygiene can fail to be appalled at the magnitude and the seriousness of the problem. The Commonwealth would be amply justified and amply rewarded in utilizing the full-time service of a corps of dentists and dental hygienists. But funds not being available, Dr. Kent generously offered his services gratis, for such time as he could spare to the work, provided the Department would appoint a graduate dental hygienist to work under his direction. This proposal was accepted with gratitude by the Department, and thus a beginning has been made in what ought justly soon to grow into an important activity.

A fundamental change in the scope and character of our work occurred during the fiscal year with the passage of the act reorganizing and consolidating the departments of the State government. By this act the management of the four tuberculosis sanatoria and of the Hospital for Lepers was transferred to this Department. This results in the Department being projected directly into the field of curative medicine, and serves as a precedent for an indefinite expansion in these lines in the future under the guise of State medicine. The prospect does not appeal to me personally as necessarily best for the general

public or for the most economical and efficient future development of preventive medicine. But it seems to be the tendency of the times, as can be seen by similar and much more radical innovations in England and in other States. Thus it has become our duty to do the best we can in this new field and especially to see if a closer co-ordination of activities cannot be brought about in all phases of anti-tuberculosis work. The previous Board of Trustees, who had managed these institutions from their inception, now more than twenty years ago, has established a high standard of efficient, humane and economical management. To maintain this standard will call for our best efforts.

This previous efficient Board having been abolished as a part of the general scheme of consolidation, it has fortunately bequeathed to the Department no heritage of friction or disorganization, but a splendidly equipped, "going" organization, which has simply been incorporated into the Department as this fiscal year expires as a Division of Tuberculosis. Dr. William J. Gallivan, a former member of the Boston Board of Health, and a member of our Public Health Council since its creation, becomes the director of the new division, and under his able leadership I confidently expect great stimulus and development of our already well-planned and organized campaign against the great white plague.

DISEASE PREVALENCE.

Last year closed with the first wave of the terrible influenza epidemic just past and with the secondary wave definitely in progress. Massachusetts suffered among the first of the States from the invasion, and with the possible exception of Pennsylvania was more severely afflicted at the beginning than other States. It was perhaps only due to the natural laws of susceptibility of population that the secondary waves of the epidemic in this Commonwealth were relatively very light. The disease prevailed sporadically during the early winter and finally died down to endemic proportions in the early spring. Encouraging results were obtained on a limited scale in the treatment of influenza-pneumonia with the serum of recently recovered cases, and with the advent of warm weather it became gradually apparent that the disease was dropping below its ordinary sporadic frequency. This fortunate condition has persisted until now it would appear that we may safely hope that there will be no recurrence of the disease on any epidemic scale during the coming winter.

We know no more about the etiology or means of prevention of this dreadful visitor than we did before its recent world-wide spread. It is a fact, however, all too little appreciated in this country, that although the mortality was terrific among us, in other sections of the world,

especially in countries where our standards of disease prevention are unknown, the mortality was proportionately so much greater that it furnishes an impressive and abundant answer to the question, "Do sanitation and preventive medicine pay?"

In direct contrast to the gloomy record of 1918, it is encouraging to record a year of extremely low prevalence of, and low mortality from, our usual infectious diseases as a group. Unfortunately, it is never possible to have final or correct figures for deaths at the date when the law requires this report to be filed. However, we do have complete returns for cases of these diseases, complete death reports for ten months, and sufficiently complete preliminary reports for the remaining two months to enable general comparisons to be made with substantial correctness.

If we take the prevailing communicable diseases as a group, we find that 1919 has established a new record for comparative freedom from infection and a most impressive decline in mortality. I have included in this group diphtheria, infant paralysis, epidemic meningitis, measles, pneumonia, scarlet fever, smallpox, pulmonary tuberculosis, typhoid fever and whooping cough: —

DISEASE.	DEATHS.	
	1918.	1919.
Diphtheria, ...	604	591
Infant paralysis, ...	38	17
Epidemic cerebrospinal meningitis, ...	228	181
Measles, ...	533	183
Pneumonia, ...	9,787	2,508
Scarlet fever, ...	77	130
Smallpox, ...	—	2
Tuberculosis, pulmonary, ...	5,106	4,200
Typhoid fever, ...	160	103
Whooping cough, ...	719	319
	17,252	8,234

The difference for the two years in the aggregate deaths from these diseases is so great as to be startling and at once excites many chains of speculation as to the precise reason back of so satisfactory a statistical showing. It would be presumptuous to attribute all or even the lion's share of this result to the activities of this Department and all our fellow health organizations in the cities and towns. Something may perhaps be attributed to the influenza epidemic of last year

resulting in the taking off of the weakest and most susceptible of the population. This argument may hold true for tuberculosis, and, to a great degree, is unquestionably almost entirely the cause of the great decline in pneumonia deaths, but it does not explain in a satisfactory manner the decline in the mortality from the other diseases. Careful examination will show this tendency operating for several years back, with certain fluctuations from year to year, but, on the whole, with a remarkable downward trend. I am strongly of the opinion that a large share of the credit for this result belongs to the Department of Public Health and the local health boards. A natural cautiousness bred into health administrators on account of the uncertain factors in communicable disease prevalence and mortality, plus, perhaps, a certain degree of false modesty, has kept us from impressing sufficiently upon our fellow citizens what the true meaning of these figures is, or how much saving they represent, not only in terms of life but of suffering, and in loss of time and in cost to the several communities, the State and the Nation.

If this point were made more clear, there might be a correspondingly more generous support of health departments with vastly greater results in diminution of disease than we can show up to the present.

As an example, let us consider the following figures for typhoid fever in Massachusetts for a series of years, bearing in mind that the total population and hence the density of population has been steadily increasing, factors that in themselves, unless carefully counteracted by sanitary science and modern hygiene, tend to greatly *increase* the prevalence of this disease:—

YEAR.	Cases.	Deaths.	Death Rate.
1908, ...	3,736	517	16.0
1909, ...	2,743	390	11.8
1910, ...	3,452	411	12.2
1911, ...	2,238	302	8.8
1912, ...	2,088	269	7.7
1913, ...	2,398	280	7.8
1914, ...	2,333	268	7.4
1915, ...	2,204	247	6.7
1916, ...	1,515	172	4.6
1917, ...	1,546	178	4.6
1918, ...	1,067	160	4.1
1919, ...	938	103	2.6

These results do not just happen. There is a reason for them. In the case of typhoid fever our figures are now showing steady improvement year by year as a result of the intelligent application of preventive principles. Eternal vigilance, however, is the price of freedom from typhoid epidemics. In this field the policy of constant watchfulness by the District Health Officers and epidemiologist and the increasing efficiency of the local boards of health working in closest possible co-operation with our staff show such striking results that they are obvious at a glance. If we had merely held our own in typhoid control in the past two years, making proper allowance for our increase of population, there should have been in the neighborhood of 4,000 cases and 500 deaths instead of the actual results. Aside from the humanitarian satisfaction inherent in these figures, they mean a progressive economic saving to the Commonwealth and its citizens of at least \$1,000,000 annually.

Assuming that the present machinery for disease prevention is maintained and gradually improved, I can see no good reason why we may not predict with some confidence the practical extermination of endemic typhoid in this Commonwealth within the next decade.

The pulmonary tuberculosis returns for the year are surprisingly good. Coming immediately after the culminating high death rate of 1918 (130.2 per 100,000), which was the climax of a steadily increasing rate for three successive years, this at once arouses the most acute interest as to the reason for a decrease in mortality amounting to nearly 900 less deaths and representing a drop in rate to the new low death rate for the Commonwealth of approximately 106 deaths per 100,000 of population, the previous low record of 1915 being 113.1 per 100,000.

It would be peculiarly gratifying if good grounds existed for attributing all or the major portion of this result directly to our anti-tuberculosis activities, but candor compels the admission that such an explanation is not justified by the facts. I am frankly at a loss to account for such a remarkable diminution, but I believe that two factors largely enter into it, viz., (1) the cessation of war and (2) the abnormal mortality from the influenza epidemic of 1918. At the same time there are the best of scientific and statistical grounds for believing that without the resources for fighting tuberculosis that our system of sanatoria, hospitals, dispensaries and home visiting nursing service furnishes the Commonwealth, the war-time tuberculosis rates would have been much more disastrous and discouraging than they were and that no improvement of such magnitude would have been recorded for this year.

Tuberculosis mortality fluctuates from year to year and it would be

unreasonable to demand that we must always keep our future death rate below this new low figure. But when enough perspective is utilized the hard fact remains that the tuberculosis death rate and case prevalence rate are steadily declining in Massachusetts and at a reasonably rapid pace.

Most tuberculosis authorities to-day feel that the tuberculosis problem is inextricably interwoven with the problem of child hygiene and especially with the problem of childhood and adolescent nutrition. For this reason as well as for many others I feel it should become a major policy of this Department to foster and stimulate in every way all movements designed to improve the nutrition of the growing child. Small but not insignificant beginnings of work in this special field have been inaugurated by the Division of Hygiene, but it is to be hoped that this Department, all local boards of health, educational authorities and many other organizations may expand nutritional work to a very great extent in the immediate future.

In the field of adult pulmonary tuberculosis the great objective may be summed up in the problem of "getting them earlier." The chance of cure or indefinite "arrest" of consumption by a period of treatment in our tuberculosis institutions bears almost a direct geometrical ratio to the promptness with which the disease is recognized and the patient admitted. This problem of getting the incipient or early case into the institutions built for and adapted to his needs has been the stumbling block for the past two decades. From experiments already fairly well tested in this State, it would seem as if a consulting service, particularly for the rural towns, is the only real answer to this vexatious problem.

The year has not been noteworthy as regards any of our other common communicable diseases. Toward the end of the year scarlet fever became abnormally prevalent in many parts of the State, but up to the present the disease has fortunately been of a mild character and the total deaths for the year are not above the average.

Diphtheria, measles, scarlet fever and whooping cough are still taken too much for granted by our citizens. Diphtheria, for instance, is perhaps more definitely controllable than any other serious disease of an acutely infectious nature. By laboratory methods it is possible to detect its presence, to detect carriers, to determine what individuals are susceptible to it, by simple and harmless methods to artificially render such susceptible persons immune for long periods of years, and to combat the poison of the disease with complete success by means of antitoxin if this is administered within the first twenty-four hours. Yet the prevalence of this disease is alarming and the mortality from it a pitiful tragedy because so unnecessary. The Department is inaugurating an intensive campaign designed to arouse the public as to

the importance of having every suspicious "sore throat" seen early by a competent physician and this needless "slaughter of the innocents" prevented.

But here again we are prone to be blinded as to our progress by viewing our results from too close a standpoint. If we take the trouble to study critically the death returns from all these common infectious diseases of children for any considerable number of years, it is surprising to discover how our death rates from them have gradually diminished, until now our "bad" years witness few if any more deaths than the most favorable years of a generation ago.

And here once more I believe that health departments have been too modest, or, perhaps, so afraid of the yearly variations of prevalence and mortality that we have not emphasized enough the steady gains made in fighting these maladies. There is no reason to suppose that the nature of these diseases has changed; and I do not believe that climatic changes, living conditions, or any other factors can explain this decline in mortalities except the increasing efficiency of health departments and the slowly increasing popular comprehension and co-operation in carrying out isolation and other administrative measures designed to check the spread and diminish the mortality of such diseases.

The average death rate from scarlet fever in Massachusetts for the last nine years, 4.4 per 100,000 of population, is exactly one-half the average death rate of the five years from 1905 to 1910, 8.7 per 100,000. Diphtheria shows a decline of nearly one-third in the average mortality for the same period. Whooping cough shows a distinct though much less pronounced decline; measles a slight average decline, but one so slight that it is hard to see that any real advance has been made in reducing its mortality.

INFANT MORTALITY AND CHILD HYGIENE.

Encouraging advances are recorded in the matter of infant mortality for the past year. In this field, however, the demonstrated possibilities of life saving are so greatly in excess of what we have hitherto accomplished in this Commonwealth that gratification over our gains is counterbalanced by mortification at our failure to achieve much greater gains. The most salutary example in all the world for us is perhaps New York City. No thinking person would declare the environmental conditions of congested New York equal to the average environment of the homes of the State of Massachusetts. The two populations are so nearly similar that comparisons based on aggregate populations are perfectly fair. And yet the decline of infant deaths in

New York City so far exceeds the corresponding decline in Massachusetts as to at once challenge our attention. At the present time the average New York City infant has nearly a 15 per cent better chance of survival than the average Massachusetts baby. There seem to be only two possible reasons for this: first, a shifting racial stock in New York City with increasing proportions of such races as the Jewish and Italian, which have low infant mortality rates compared to other race stocks; and, second, more intensive work on the part of the authorities in prenatal, maternity and infant care.

The opportunities for life saving in this field by an extension of nursing and obstetrical service are so great that I believe it is imperative that the maternity benefit proposals before the Legislature should receive most careful consideration by all intelligent citizens and some form of such service be made available for every expectant mother in the Commonwealth. Undoubtedly, many errors of commission and omission will mark the early history of the administration of such a law, but the practical certainty that its actual operation will quickly produce a marked and continuous decline in both maternal and infant mortality makes all such shortcomings insignificant as compared with the shortsightedness of failing to try such measures at all.

THE LABORATORY PROBLEM.

Every year for the past four years attention has been called to the increasing inadequacy of our laboratories and to the growing insistence of the authorities of Harvard University that the Department vacate the laboratories at Forest Hills now occupied by us but belonging to Harvard.

The high cost of building naturally led the Department to defer asking legislative action during the war. The war is now over, but no immediate or prospective decline in building costs is in sight, and the problem has steadily grown more urgent, until at length it has become critical. I urge that the matter be placed before the General Court in detail and that we strive by every legitimate means to impress upon the incoming Legislature the necessity of making appropriations to enable building to be begun during the present fiscal year. After carefully studying the problem again and again, I am convinced that the original plan of obtaining sufficient land to keep stables and horses in immediate proximity to the laboratory must be abandoned, and I recommend that enough land for the laboratory alone be obtained well within the metropolitan district, and if possible in Greater Boston, and the farm and stable features transferred to State-owned land well outside. Our experiences of the fire risk involved, the impossibility of

ever adopting State House space in a satisfactory manner to laboratory requirements, together with the pressing need for other purposes of the space now occupied by our laboratories in the State House, have convinced me that all our laboratory activities should be transferred to the new laboratory building, and it will be impossible to properly carry on our many laboratory activities unless the laboratory building is within easy distance of mail, express and other transportation services.

THE WATER SUPPLY INVESTIGATION.

Last year I devoted considerable space in my report to pointing out the urgent necessity of making a new and comprehensive study of the water supply needs of the Commonwealth. The General Court authorized the carrying out of this study and the work is now in progress under the joint direction of this Department and the Metropolitan District Commission. It will take at least two years to complete the study, but thereby a comprehensive policy can be adopted by the State for the necessary future extension of its water supplies. It is as yet too soon to draw any conclusions from this work.

THE PLUMBING BOARD.

For years the conflicting plumbing rules and regulations of the various municipalities of the Commonwealth have been recognized as a source of trouble and of additional expense to building operations. There should be no need of varying material and devices in order to meet the plumbing requirements of Boston, Brookline and Newton for instance, yet under our present system such is the case.

Every one directly concerned felt that a more uniform code applicable throughout the State ought to be worked out if it is at all possible to do so. Hoping to make a start in this direction I appointed early in the year a Plumbing Board, consisting of the representatives named from each of the following bodies:—

Prof. G. C. Whipple, professor of sanitary engineering, Harvard University, representing the Public Health Council of this Department.

James C. Coffey, executive officer, health department, Worcester, representing the State Examiners of Plumbers.

Thomas M. Wilson, chief tenement house inspector, building department, Boston, representing the New England Association of Plumbing Inspectors.

Edward C. Kelly of Boston, representing the Massachusetts State Association of Master Plumbers.

Patrick J. Osborne, supervisor of plumbing in the Boston schoolhouse department, representing the Massachusetts Association of Journeymen Plumbers.

These experts have attacked the various complex problems with enthusiasm, have met regularly each week throughout the year, have amassed a truly astonishing amount of expert information on this intricate subject, and have outlined a constructive plan to serve as a basis for forming a new plumbing code. I feel that this masterly report should have wide circulation among all interested in the subject. I also heartily approve the recommendation of this Board that legislative authority be sought to empower this Department to continue the study and to draw up a complete plumbing code to be submitted to the General Court of 1921 for adoption.

NATIONAL HEALTH PROBLEMS.

In common with all State health executives I have been compelled during the past year in the interests of our own State to devote no little time to the question of co-operation with Federal departments and bureaus in certain phases of health work.

Under the terms of the Chamberlain-Kahn act the United States government now extends very substantial financial assistance to the several States in the matter of venereal disease control (\$36,000 annually to Massachusetts). The same principle has been invoked in proposed legislation for rural sanitation, physical education, infant welfare, and general health administration, inspired by nearly as many different Federal departments as there are proposals. This Federal aid extension principle is a live issue at present in many lines of governmental activity. It is by no means clear that the principle is sound, and the merits of such proposals are further confused by the present state of uncertainty in the Federal government as regards health measures, because, as just stated, so many different Federal departments are sponsoring various health policies with practically no relation to each other and no co-ordination.

The attitude of nearly all State health executives is that we should first strive to bring about a more definite co-ordination of all Federal health activities, and then take up such questions of policy as the Federal subsidy to the States in health work, for example, on their merits, with that Federal department or commission which is finally made responsible for carrying out all the health policies of the national government. For instance, a Federal department whose work takes it into some special corner of the health field, finding the machinery for dealing with its specialty weak or lacking in many States, forthwith proposes as a solution the creation of a Federal subsidy fund to be administered by itself on such terms that the development of this phase of health work throughout the country shall be dictated from

Washington, entirely subordinating the initiative and moral responsibility of the several States. No matter how well meaning such policies may be in the beginning there is grave danger they will lead to a parasitic existence on the part of State and municipal departments. If such a development occurs, in the long run the public welfare of the several States will be less wholesomely promoted than by a slower evolution of such work, dependent upon the impetus of public sentiment within the State bringing into operation the legislative and financial machinery for achieving the same praiseworthy ends.

Whatever the outcome, the war has forever radically changed the degree of contact of the State health departments with Washington. Even those of us who wish we could get back to the very loose contact of pre-war days (in which class I personally belong) recognize the impossibility of such a solution. For good or ill the tendency of the times is the other way.

CO-OPERATION WITH VOLUNTEER HEALTH AGENCIES.

For years all progressive health departments have recognized the great value in their own work of close co-operation with such bodies as tuberculosis societies, baby hygiene associations, visiting nursing organizations, mental hygiene associations and others of like nature. As these organizations have grown in resources, membership and popular prestige, some of them have become great national influences in the field of public health. The American Red Cross as a result of its war activities has come to occupy a pre-eminent place among such voluntary civic welfare bodies. It has decided as one of its peace time activities, in fact as its great activity, to enter the field of public health and particularly to promote the movement for wider utilization of public health nursing service throughout the country. It must be admitted, in spite of the clear declaration of policy by the Red Cross that it intended in no sense to compete with or absorb existing private or public agencies already engaged in public health nursing work, that in many quarters the expansion of public health nursing work by the Red Cross has been viewed with suspicion and apprehension by other agencies already in the field. From careful study of the development of the Red Cross plan I am convinced that there is nothing in their policy which is in any way detrimental to the best interests of any health department's or voluntary organization's public health nursing plans, and I therefore urge that the closest co-operation between the Red Cross and this Department, as well as all the city and town boards of health of the State, be striven for.

For many years past the closest and heartiest co-operation with the

State Tuberculosis League and its subordinate associations has been maintained. I attribute in no small degree the advanced position Massachusetts holds in tuberculosis work to this fact, and particularly to the statesman-like policy of our tuberculosis societies' executives in always transferring to the State and local health authorities definite activities as soon as the general public appreciates their value to such an extent as to be willing to support such work as part of the proper province of the health authorities. This has never meant a cessation of endeavor by the tuberculosis societies, but rather their constantly turning to other pioneer work in the tuberculosis field.

LEGISLATION RECOMMENDED.

The following recommendations for legislation have been submitted to the General Court: —

1. An act relative to the appointment of school nurses in cities and towns.
2. An act to provide for clean, sanitary and healthful food establishments.
3. An act relative to the analysis of liquor by the Department of Public Health.
4. An act relative to the use of methyl alcohol.
5. An act authorizing cities and towns to establish and maintain centers for preventive health work.
6. An act relative to the dissemination by advertising or otherwise of information concerning certain diseases.
7. An act relative to the maximum compensation of District Health Officers and the number of such officers that the Department of Public Health may have.
8. An act transferring certain duties of the State Department of Health (Department of Public Health) to the Metropolitan District Commission.
9. A resolve authorizing the Department of Public Health to study and investigate the relation of medical social service to public health problems.
10. An act amending the present cold-storage law.
11. A resolve authorizing the Department of Public Health to make an investigation as to the advisability of revising and codifying certain rules and regulations relative to plumbing.

DIVISION OF ADMINISTRATION.

Several factors have added greatly to the work of the Division of Administration during the past year. For example, the methods of handling personnel matters have been completely revised in order to comply with the regulations promulgated by the office of the Supervisor of Administration. The addition of any new function, as, for example, the transfer of the tuberculosis sanatoria, increases in-

evitably the labor of the Division, even with the simplest sort of system maintained to keep record of the routine activities that must pass through the office of the Commissioner, and it is absolutely essential that another stenographer-clerk be added to the force to relieve the heavy overload of work now being carried.

This Department has never organized the Division of Administration with a director, such duties being performed by the Commissioner and his secretary, but with the increase in size and complexity of the Department's activities the point has already been passed when the Division should have a separate director and assume more completely its proper function as a supervising organization for the routine fiscal, field and record work of the entire Department. I recommend that the Council give this question serious consideration during the coming year with a view to making such a recommendation to the General Court of 1921. It is to be remembered that all the work of the Public Health Council itself is also carried out by the Commissioner's secretary. It is interesting to note that in a neighboring State department of health an executive clerk at \$4,000 salary and a departmental secretary at \$4,500 are necessary to carry on the functions of the administration division.

DIVISION OF SANITARY ENGINEERING.

The total number of applications received from cities, towns and others, for advice with reference to water supply, drainage, sewerage and similar subjects, presented for the consideration of this Division during the year 1919 was 146 as compared with 147 in 1918. The character of the work called for under these applications is much the same as in the previous year. As in all the years since the war began, the construction and extension of municipal works in water supply, drainage and sewerage have been confined to meeting the most pressing requirements.

The rainfall during the year, especially during the summer and autumn seasons, has been much higher than usual; consequently, there has been little difficulty from shortage of water supply, while, on the other hand, the comparatively high flow of streams has reduced to a minimum the effects of river pollution.

In addition to the regular work of the Division, certain special duties imposed upon the Department by the Legislature of 1919 have been referred to this Division for investigation and report. These are —

Report relative to the pollution of the Charles River. (Chapter 9, Resolves of 1919.)

Report relative to the pollution of the Blackstone River. (Chapter 15, Resolves of 1919.)

Investigation jointly with the Metropolitan Water and Sewerage Board of the water supply needs and resources of the State, including the use of Great Ponds. (Chapter 49, Resolves of 1919.)

Resolve extending the time for the report of the State Department of Health, upon the cost of a sewerage system to prevent the pollution of the Mystic Lakes in the towns of Arlington and Winchester and the city of Medford. (Chapter 14, Resolves of 1919; former act, Chapter 34, Resolves of 1918.)

Investigation as to the pollution of the Taunton River and its tributaries. (Chapter 29, Resolves of 1919.)

In accordance with these provisions these matters have been reported upon direct as special reports to the General Court of 1920.

The work of ascertaining the area and ownership of lands benefited by the improvement of the Neponset River under the provisions of chapter 655 of the Acts of the year 1911, and acts in amendment thereof and in addition thereto, has been completed during the year, and the work of estimating the special benefits to these lands as provided by the act is now under way. The determination of the ownership of these lands has been a tedious and difficult one under the circumstances, but it has been carried out, it is believed, with sufficient thoroughness to meet the requirements of the statutes.

Of the special investigations called for by the Legislature, by far the most important is that which requires the investigation of the water supply needs and resources of the Commonwealth. This work is the most important undertaken by the Department for many years in its relation to the health and comfort of the people of the State. The growth of the metropolitan district has reached a stage where the first enlargements of the system will soon become necessary, as expected when the construction of the works was begun in 1895. In the meantime, other large areas in the neighborhood of the metropolitan district and elsewhere are in need of a large increase in their water supplies. This work was organized as promptly as practicable after the passage of the necessary legislation, and the investigations in the field have begun.

The season has been an unfavorable one for the satisfactory determination of the condition of the rivers called for in the special acts of the Legislature of 1919, chiefly for the reason that the rainfall has been large and the flow of the streams unusually high.

On the other hand, there has been a marked increase in manufactur-

ing and a growth in the number of manufacturing establishments which discharge considerable quantities of offensive waste which have caused an increase in the pollution of streams likely to be felt seriously unless cared for when seasons of low rainfall again occur.

Under the provisions of chapter 289 of the General Acts of 1919, relative to the improvement of certain low lands, the Drainage Board, created by that act, has, in response to a petition, made the necessary surveys to determine the practicability and cost of diking and draining certain marsh lands lying west of Salisbury Beach near the boundary line between Massachusetts and New Hampshire. Some of these lands in fact lie within the latter State, and the necessity of confining the work to the State of Massachusetts makes the cost of the work greater than would probably be the case if the favorable conditions found just within the New Hampshire boundary could be utilized in the construction of the works. The information collected has been reported to the proprietors as required by the act.

DIVISION OF WATER AND SEWAGE LABORATORIES.

In the laboratories of this Division the usual large number of chemical, bacterial and microscopical examinations of samples from the water supplies, rivers, etc., in the State were made during the fiscal year. This analytical work included 5,550 chemical, 1,800 microscopical and 1,020 bacterial analyses. Special studies of sewage areas, the purification of sewage, trade wastes and purification of water required 3,050 additional chemical and 1,800 bacterial examinations. Besides these analyses 574 determinations of lead, manganese, etc., were made in connection with studies of corrosion, manganese in ground water and similar questions. Much field work was done in co-operation with the Division of Sanitary Engineering, which included 1,051 determinations of dissolved oxygen, carbonic acid and alkalinity.

Special studies were made during the year on the following subjects:—

Examination of shellfish from different areas to determine (1) the variation in degree of pollution of clams from polluted sources during the different seasons of the year, and to determine (2) the varying bacterial content of clams from grossly polluted, slightly polluted, and practically unpolluted sources; methods of the disposition of trade wastes from different factories in the State; recovery of fertilizing material and grease from the treatment of sewage by plain sedimentation, chemical precipitation and by the Miles acid process, so called, using both sulphuric and sulphurous acid as a precipitant; modifications of the activated sludge process, including purification by agita-

tion without the use of air, and on methods of dehydrating sludge by centrifugal machines.

During the year studies were also made of the self-purification of sewage in large bodies, the purification of different water supplies in the State, and the treatment of water with chlorine, especially the Lawrence municipal supply after filtration, and the new Beverly and Salem supply. The removal of color from water by methods already described, and by a modification of the Anderson process, so called, which seems to promise success, has also been carefully investigated, together with the question of the control of the quality of water in swimming pools.

DIVISION OF COMMUNICABLE DISEASES.

The activities of the Communicable Disease Division have continued along the same general lines as in former years, with additional stress being placed upon the control of diphtheria and typhoid fever.

Constant effort has been made to impress upon the general public the fact that many of the deaths resulting from communicable diseases are needless. In this work, publicity has been sought at various times through the daily press and in bulletins, in an endeavor to bring to the minds of the people the need of earlier and more complete diagnosis in suspected cases of communicable disease.

The work of the subdivision of venereal diseases has increased tremendously during the year. As the machinery for the handling of this work becomes more efficient we find that our problems have become more and more specialized in nature. Increased investigation of sources of infection, together with more intensive medical-social follow-up with the object of placing under treatment the lapsed case, has been instituted with quite appreciable results. Here lies the greatest chance for the prevention and control of venereal diseases. During the ensuing year special effort will be made to make this work more effective by placing trained social workers in these clinics in order that the dangerously infected person may be placed under supervision, and, when necessary, under control, without delay.

Circularization of various organizations, doctors, dentists and pharmacists has been intensively carried out by letters and pamphlets, and lectures to various groups of people have been given during the year by members of our force.

A particularly effective means of placing information before selected groups has been the so-called "study group." Small groups of intelligent people have been gathered together and by lectures and the use of Stokes' "World Problems in Disease Prevention" medical facts con-

cerning gonorrhœa and syphilis have been explained. It is hoped that from these small units a large amount of knowledge will be disseminated to other persons or groups where it will be of much service.

At this time all of the sixteen State-approved and subsidized clinics are in operation and it appears that in the near future others will have to be established in order to adequately care for the increasing number of patients. Attendance at venereal disease clinics offers the greatest opportunity for the control of the actual case, and advertising the time and place of holding the clinics in the respective areas should result in a great increase in the number of patients coming under treatment.

The work of the subdivision of tuberculosis is approximating the results hoped for, and with still more intensive "follow-up" by local authorities even better results can be expected.

Three county tuberculosis sanatoria are in operation, with a fourth to open at an early date. It is certain that, with co-operative efforts of the local boards of health, their nursing force and this Department, these institutions can easily be filled to capacity.

The Bacteriological Laboratory has had a most successful and industrious year, having examined more than 25,000 specimens, an increase of 3,000 over the preceding year.

The total number of all kinds of examinations made follows:—

	DIAGNOSIS.		RELEASE.		*Atypical.	Total.
	Positive.	Negative.	Positive.	Negative.		
Diphtheria, . . .	1,366	8,463	1,641	3,455		14,925
Tuberculosis, . . .	949	2,800				3,749
Typhoid fever:—						
* Widal test, . . .	370	1,171			81	1,622
Culture test, . . .	59	491				550
Gonorrhœa, . . .	417	3,610				4,027
Malaria, . . .	3	88				91
Pneumonia, . . .						497
Miscellaneous, . . .						293
Total, . . .						25,754

The State, as a whole, has been unusually free from communicable diseases for the past year. The totals for all reportable diseases are 80,239 cases for 1917, 249,020 for 1918, and 112,089 for 1919. Excluding cases of lobar pneumonia and influenza for this three-year period, nearly all of which for 1918 and 1919 represent the effect of the epidemic, the figures are 78,483 cases in 1917, 90,384 cases for 1918,

and 67,087 cases for 1919. This remarkable showing for 1919 becomes more pronounced if the total returns for venereal diseases are excluded. These diseases were reportable only during part of 1918, and not at all during 1917. With their exclusion the comparative figures for the reportable diseases are 78,483 for 1917, 79,419 for 1918, and only 53,525 for 1919.

Scarlet fever and diphtheria were present in ordinary amounts until the latter part of the year when scarlet fever of a mild type became very prevalent all over the State during the past two months. Diphtheria also increased markedly over 1918, but the monthly average did not exceed the monthly incidence for the past five years.

There were only seven small outbreaks of typhoid fever. The largest one, reaching a total of 38 cases, was due to an infected water supply. Another outbreak due to milk infected by a typhoid carrier was responsible for 29 cases, while two others, due to a polluted well and spring, respectively, caused 13 and 18 cases. The last large outbreak of 10 cases was apparently due to food infected by a typhoid carrier. This sets a new record for the State. The remaining cases of typhoid have all been sporadic. In 209 instances it has been necessary to make special epidemiological investigations, distributed as follows:—

Smallpox, ...	40
Anthrax, ...	18
Measles, ...	20
Scarlet fever, ...	19
Diphtheria, ...	23
Epidemic cerebrospinal meningitis, ...	14
Typhoid fever, ...	13
Whooping cough, ...	3
Leprosy, ...	3
Chicken pox, ...	1
Lethargic encephalitis, ...	33
Mumps, ...	4
Tetanus, ...	3
Malaria, ...	1
Pellagra, ...	1

Upon milk farms:—

Diphtheria, ...	3
Smallpox, ...	1
Scarlet fever, ...	6
Typhoid fever, ...	3

In smallpox, anthrax, epidemic cerebrospinal meningitis, leprosy, lethargic encephalitis, tetanus and pellagra the individual cases were investigated.

Because of the unusual prevalence of disease in certain communities "outbreak notices" were sent to the District Health Officers in 64 instances. The number of notices sent for each disease was as follows: —

Scarlet fever, ...	14
Measles, ...	20
Diphtheria, ...	19
Typhoid fever, ...	3
Whooping cough, ...	3
Malaria, ...	1
Mumps, ...	3

During the twelve months ended Nov. 30, 1919, 497 specimens of sputum were examined for pneumococci. Of these, 212 showed no pneumococci and 285 showed pneumococci of the following types: —

Type I.	Type II.	Type III.	Type IV.
41	33	66	145
14.4%	11.6%	23.1%	50.9%

During the twelve months 13 typhoid carriers were found.

DIVISION OF BIOLOGIC LABORATORIES.

The principal task of the Division during the fiscal year covered by this report was the readjustment from war conditions. The laboratory at Forest Hills is practically a factory for the production of serums, antitoxins and other prophylactic and diagnostic products. Much difficulty was encountered in obtaining certain supplies, and the constantly increasing costs rendered the financial situation increasingly uncertain. As an example of the handicap under which the work of the laboratory was done, it was impossible, for one thing, to obtain dialyzing paper. This paper is necessary to concentrate and purify diphtheria antitoxin. The difficulty in obtaining this material necessitated certain changes in the production and distribution of antitoxic serum.

While some of the personnel of the Division entered war service, the work of the laboratories suffered no serious interference for this reason. On the other hand, both the Antitoxin and Vaccine Laboratory and the Wassermann Laboratory were able to co-operate with and assist both the Army and Navy in many ways.

The following table summarizes the work done at the Antitoxin and Vaccine Laboratory during the fiscal year 1919: —

	1919.	1918.
Vaccine virus (doses), ...	196,277	217,650
Typhoid prophylactic (doses), ...	16,735	24,578
Paratyphoid prophylactic (doses), ...	1,615	1,950
Typhoid-paratyphoid (doses), ...	56,316	25,263
Diphtheria antitoxin (doses), ...	130,195	123,039
Antimeningitis serum (bottles), ...	4,452	4,558
Pneumococcus: —		
Type I (bottles), ...	369	357
Type II (bottles), ...	189	366
Schick outfits (bottles), ...	9,600	6,400
Toxin-antitoxin (doses), ...	1,133	426

The activities of the Wassermann Laboratory have not been unusual during the present year. There have been a few minor changes in personnel designed to make the work more efficient and less expensive.

The efforts made by this and other departments in the control of venereal disease have shown the desirability of statistical data with regard to both syphilis and gonorrhœa. Although the Wassermann Laboratory has collected a wealth of such material, it has been delayed in placing this in available form because of lack of clerical assistance. This work, however, is now proceeding with rapidity, and it is hoped that at a very early date valuable statistical data will be in form for publication.

The Wassermann Laboratory has continued to co-operate with the Bureau of Animal Industry in making diagnostic tests for glanders, rabies and other infections of animals.⁴

The following table indicates the routine examinations made and their number: —

	1919.	1918.
Wassermann tests, ...	31,804	27,534
Gonococcus fixation tests, ...	150	—
Complement fixation tests for glanders, ...	126	646
Agglutination tests for glanders, ...	—	215
Diagnostic examinations for rabies, ...	80	61
Pathological and bacteriological examinations, ...	85	45

In most instances the number of tests and examinations performed exceeds that of last year. The only exception to this is in the case of tests for glanders.

DIVISION OF FOOD AND DRUGS.

The work of the Division of Food and Drugs has increased about 18 per cent over the year 1918. During the first eleven months 12,989 samples were examined and 236 cases have been prosecuted, the total fines imposed being \$7,195. Ninety-five confiscations have been made, the combined weight of such confiscated articles amounting to 250,008 pounds.

The State was covered more thoroughly than has been possible previously by the use of an automobile carrying two inspectors and one chemist, together with sufficient laboratory equipment for preliminary examinations. In this way many districts not readily accessible by railroad were visited. The Division is indebted to Mr. Morrill of West Springfield, Mr. Mecarta of Barnstable and Mr. Hyde of North Adams, local milk inspectors, as well as Dr. Lindsay, director of the Amherst Agricultural Experiment Station, who permitted the use of their laboratories on some of these trips.

An unusually large number of liquor samples have been submitted by police departments, and it was found that the privilege of free analysis has been abused, because a large number of these samples were submitted by the United States Internal Revenue Department, through the medium of the police departments, the samples being obtained from dealers licensed to sell such liquors by Massachusetts licensing boards.

An investigation of soft drink factories has been made with a view to improving sanitary conditions in such establishments. It was found that they are frequently operated with practically no thought of cleanliness or decency, and conditions which would not be tolerated upon any dairy farm are quite common in such establishments. A sanitary food law should be enacted to prevent such establishments from competing with those bottlers of high-grade products produced in clean factories under clean conditions.

The Division presented evidence of violation of the cold-storage law in the so-called fish conspiracy case, tried by the Attorney-General in the Suffolk District Superior Court. It so happens that there is more violation of the cold-storage laws in relation to fish than in relation to any other article of food, due probably to the fact that the law permits fish to be placed in cold storage undated, while all other food-stuffs must carry the date of entry when placed in storage. In one instance an attempt was made to put a carload of fish in storage in

Boston, which, though originally salt-water fish, had been stored in Chicago, shipped from New York to Boston, and, when this Department refused admission to Massachusetts storage because of its age, was shipped to Cleveland, Ohio, for storage.

It was necessary to grant eighty extensions of time in storage during the first eleven months of the fiscal year.

Owing to a disastrous fire in the laboratory from the breaking of a carboy of ether, resulting in the loss of one life, the arsphenamine work was removed from the State House to a laboratory building in the Fenway, Boston. It was estimated that this would curtail production for about two months, and a large surplus of arsphenamine was prepared. The transfer of apparatus, delays in new construction, and the strike of electric linemen, resulted in a delay of five months. The production will soon be brought to the former rate, however.

DIVISION OF HYGIENE.

The activities of the Division of Hygiene for the year may be summarized under the principal headings of public health nursing activities, food in relationship to health, mouth hygiene, work against cancer and educational work.

In order to be able intelligently to advise towns regarding their public health nursing needs, this Division co-operated with the District Health Officers during the past year in a survey which included an enumeration of the existing nursing facilities of the different communities, together with an estimate as to future needs. Special studies have also received attention. The Division is now engaged in a study of the midwife situation in Massachusetts, of open-air classes, and of the various factors which would enter into a system of maternity benefits.

The work of food in its relationship to health has been extended greatly during the past year, though no new personnel has been employed. Food exhibits and lecture material have been considerably extended. It is felt, however, that a need exists for the broader treatment of the subject. Disconnected efforts are being made by various organizations to handle parts of the problem. A State-wide policy is sadly needed so that every ounce of effort may tell. Nutrition clinics need to be stimulated and, when obtained, standardized. To this end the Division is making a study of existing clinics. Experts in dietetics ought to be available in every community. Such experts would logically be attached to health centers where such exist. From these centers would radiate an influence which would touch the schools and the home, making possible a more rational attention to the basic nutritional needs of the community.

Another new departure this year has been the appointment of a

supervisor of mouth hygiene. This branch of work has been too long neglected as a factor in preventive medicine. As a result of these activities new dental dispensaries will be established, standardization accomplished, and the public instructed as to the part which mouth hygiene can play in the preservation of health.

The work of furnishing diagnostic service for physicians with patients who possibly may have cancer has been continued. The work, as heretofore, is carried out in co-operation with the Cancer Commission of Harvard University. In addition to this service, all the physicians of the State have been furnished with a pamphlet prepared by the American Society for the Control of Cancer and dealing with the diagnosis and treatment of this disease.

Our lecture service has been extended wherever possible to reach all influential groups which can further the cause of public health. In all, 571 lectures were given by the Department to aggregate audiences of over 100,000 persons. The health exhibits of the Division have been increased and improved. Important relationships have been established with the Massachusetts Tuberculosis League, the Massachusetts Child Labor Committee, and the League for Preventive Work, whereby the health exhibits maintained by these organizations travel with ours. In this way all reach a larger audience at a smaller overhead expense. New pamphlets have been issued from time to time. Probably the most important of these has been an outline for teaching child welfare, which was prepared in co-operation with the State Board of Education for use in vocational and other schools.

Preparations are now under way to establish a lecture course on the outlines of public health nursing for training schools in nursing. These lectures will be given by the District Health Officers and the personnel of the Division of Hygiene.

An innovation this year was the maintenance of a diagnostic service for children at the agricultural fairs. A physician skilled in pediatrics was present to examine children and to advise with parents. No treatment was offered, all cases in need thereof being referred to their family physician. This service was offered largely as an educational measure and was decidedly successful. It is recommended that this diagnostic service be made permanent and extended to the whole State, especially throughout the rural sections.

APPROPRIATIONS.

The appropriations for the year ended Nov. 30, 1919, as recommended by the Commissioner of Health in the annual estimates made under the provisions of section 26, chapter 6, of the Revised Laws, were as follows:—

REGULAR APPROPRIATIONS.

For the Division of Administration, ...	\$28,700 00
For the Division of Hygiene, ...	27,850 00
For the Division of Communicable Diseases, ...	101,350 00
For antitoxin and vaccine lymph, ...	50,300 00
For the manufacture and distribution of arsphenamine, ...	19,200 00
For the Division of Food and Drug Inspection, ...	34,000 00
For the Division of Water Supply and Sewage Disposal, ...	66,000 00
For the State Examiners of Plumbers, ...	4,800 00
For an investigation relative to the causes of cancer, and for further investigations for the treatment or prevention of cancer, ...	3,000 00
Total, ...	<u>\$335,200 00</u>

SPECIAL APPROPRIATIONS.

For the control, suppression and treatment of venereal diseases, balance from 1918, ...	\$10,490 01
For ascertaining the cost of a sewerage system to prevent the pollution of the Mystic Lakes, ...	500 00
	<u>10,990 01</u>

EMERGENCY APPROPRIATIONS.¹

For work in connection with the epidemic of influenza-pneumonia, ...	5,000 00
	<u>\$351,190 01</u>

EXPENDITURES.

The expenditures under the different appropriations for the year ended Nov. 30, 1919, were as follows:—

REGULAR APPROPRIATIONS.

Division of Administration.

Appropriation, ...	\$28,700 00
Credit, brought over from 1918 appropriation, ...	30 17
	<u>\$28,730 17</u>
Salaries, ...	\$19,016 86
Traveling, ...	963 34
Express, ...	187 52
Printing and binding, ...	735 05
Books and subscriptions, ...	312 15
Advertising, ...	20 82
Stationery, maps and blue prints, ...	504 56

¹ Transferred by the Governor and Council from their appropriation for extraordinary expenses.

Postage and postal orders, ...	\$1,785 80
Telephone and telegraph messages, ...	960 85
Typewriting supplies and repairs, ...	226 35
Sundry office supplies, ...	166 68
Messenger, ...	257 36
Miscellaneous, ...	82 01
Total, ...	\$25,219 35
Unexpended balance, ...	3,510 82
	\$28,730 17

Division of Hygiene.

Appropriation, ...	\$27,850 00
Credit, cash returned to treasury, ...	5 70
Credit, brought over from 1918 appropriation, ...	532 11
	\$28,387 81

Salaries, ...	\$13,501 68
Traveling, ...	4,097 06
Express, ...	452 30
Printing and binding, ...	4,311 16
Books and subscriptions, ...	4 86
Advertising and educational work, ...	3,000 61
Stationery, maps and blue prints, ...	395 68
Postage, ...	386 94
Telephone and telegraph, ...	31 30
Typewriting supplies and repairs, ...	239 08
Extra service, ...	196 06
Purchase and maintenance of auto truck, ...	1,250 41
Office supplies, ...	8 77
Laboratory supplies, ...	48 27
Miscellaneous, ...	92 00
Total, ...	\$28,016 18
Unexpended balance, ...	371 63
	\$28,387 81

Division of Communicable Diseases.

Appropriation, ...	\$101,350 00
Credit, brought forward from 1918, ...	12 50
Credit, cash returned to treasury, ...	59 98
	\$101,422 48

¹ Includes 1919 appropriation for venereal diseases, against which nothing was drawn until September as there was a balance available from the 1918 appropriation for this purpose.

Salaries, ...	\$53,770 96
Traveling, ...	13,217 36
Express, ...	30 74
Printing and binding, ...	2,097 35
Books, maps and educational supplies, ...	655 42
Postage, ...	1,091 71
Typewriting supplies and rental, ...	231 35
Extra services, ...	368 05
Telephone and telegraph, ...	609 00
Office supplies and stationery, ...	982 73
Laboratory and experimental work, ...	2,445 90
Office supplies, inspectors, ...	40 10
Clinics, ...	4,975 00
Animals, ...	79 05
Food for animals, ...	14 21
Labor, ...	25 50
Miscellaneous, ...	62 10
Office rent and light, ...	741 87
Total, ...	\$81,438 40
Unexpended balance, ...	19,984 08
	\$101,422 48

Production and Distribution of Antitoxin and Vaccine Lymph.

Appropriation, ...	\$50,300 00
Credit, brought forward from 1918, ...	284 27
Credit, cash returned to treasury, ...	3 75
	\$50,588 02
Salaries, ...	\$22,651 13
Apparatus, chemicals and laboratory supplies, ...	8,478 65
Traveling, ...	203 08
Express, ...	131 93
Books and stationery, ...	713 89
Printing, ...	812 08
Purchase of animals, ...	1,300 46
Shipping, ...	1,382 62
Services of veterinary and saddlery, ...	24 60
Food for animals, ...	6,527 02
Rental of telephone, messages and postage, ...	583 11
Rent, ...	2,058 32
Water, gas and electric lighting, heating, ...	703 76

Labor and materials, ...	\$2,454 64
Ice, ...	476 38
Miscellaneous, ...	437 37
Total, ...	<u>\$48,939 04</u>
Unexpended balance, ...	1,648 98
	<u>\$50,588 02</u>

Manufacture and Distribution of Arsphenamine.

Appropriation, ...	\$19,200 00
Salaries, ...	4,336 19
Apparatus, chemicals and laboratory supplies, ...	2,329 12
Services, testing arsphenamine, ...	225 00
Animals, ...	113 50
Traveling, ...	62 37
Rent, ...	375 00
Express, ...	13 74
Labor, ...	65 00
Purchase of arsphenamine, ...	5,040 00
Heat and light, ...	53 75
Miscellaneous, ...	34 24
Total, ...	<u>\$12,647 91</u>
Unexpended balance, ...	6,552 09
	<u>\$19,200 00</u>

Division of Food and Drug Inspection.

Appropriation, ...	\$34,000 00
Credit, brought forward from 1918, ...	32 19
	<u>\$34,032 19</u>
Salaries, ...	\$25,378 14
Apparatus and chemicals, ...	601 47
Traveling, ...	5,766 77
Express, ...	89 88
Printing, ...	452 04
Books, maps and stationery, ...	317 58
Telephone, telegraph messages and postage, ...	392 45
Sundry laboratory supplies, ...	262 38
Typewriting supplies and repairs, ...	29 80
Branding outfits, ...	77 93
Samples, ...	457 81
Extra services, ...	35 00
Miscellaneous, ...	31 18
Total, ...	<u>\$33,892 43</u>
Unexpended balance, ...	139 76
	<u>\$34,032 19</u>

Division of Water Supply and Sewage Disposal.

Appropriation, ...	\$66,000 00
Credit, cash returned to treasury, ...	101 60
	\$66,101 60
Salaries, ...	51,286 19
Apparatus and materials, ...	2,967 38
Traveling, ...	5,650 68
Express, ...	1,364 01
Printing and binding, ...	1,002 28
Maps, blue prints and books, ...	202 76
Stationery, drawing materials and typewriting supplies, ...	607 39
Telephone and telegraph messages and postage, ...	234 44
Services collecting samples and reading gages, ...	350 45
Labor, ...	87 10
Rent, ...	150 00
Miscellaneous, ...	73 61
Total, ...	\$63,976 29
Unexpended balance, ...	2,125 31
	\$66,101 60

State Examiners of Plumbers.

Appropriation, ...	\$4,800 00
Salaries, ...	2,604 50
Examiner's wages, ...	405 00
Traveling, ...	457 88
Express, ...	40 88
Printing, ...	95 63
Postage, ...	95 00
Books and stationery, ...	71 38
Plumbers' materials, ...	8 00
Extra services, ...	426 50
Cleaning, ...	19 00
Office supplies, ...	3 98
Telephone and lighting, ...	101 07
Total, ...	\$4,328 82
Unexpended balance, ...	471 18
	\$4,800 00

Investigation relative to the Causes of Cancer.

Appropriation, ...	\$3,000 00
Special investigation, ...	\$833 32
Pamphlets, ...	330 00
Printing, ...	5 55
Laboratory supplies, ...	29 59
Total, ...	\$1,198 46
Unexpended balance, ...	1,801 54
	\$3,000 00

SPECIAL APPROPRIATIONS.

Control, Suppression and Treatment of Venereal Diseases (Chapter 140, Special Acts of 1918).

Appropriation, ...	\$30,000 00
Expended in 1918, ...	19,529 99
Balance, ...	\$10,470 01
Credit, cash returned to treasury, ...	1,080 82
	\$11,550 83
Salaries, ...	\$5,144 48
Traveling, ...	342 52
Express and shipping, ...	41 87
Postage, ...	19 50
Telephone and telegraph, ...	6 37
Books and stationery, ...	183 42
Printing, ...	559 26
Typewriting supplies, ...	75 60
Clinic subsidies, ...	5,025 00
Educational material, ...	152 62
Total, ...	\$11,550 64
Unexpended balance, ...	19
	\$11,550 83

*Ascertaining the Cost of a Sewerage System to prevent the Pollution of the Mystic
Lakes (Chapter 14, Resolves of 1919).*

Appropriation, ...	\$500 00
Salaries, ...	\$405 00
Traveling, ...	8 00
Total, ...	\$413 00
Unexpended balance, ...	87 00
	\$500 00

EMERGENCY APPROPRIATIONS.

Work in Connection with the Epidemic of Influenza-Pneumonia.

Appropriation, ...	\$5,000 00
Salaries, ...	\$1,477 91
Traveling, ...	592 92
Printing, ...	51 39
Postage, ...	215 00
Laboratory supplies, ...	89 66
Miscellaneous, ...	3 32
Total, ...	\$2,430 20
Unexpended balance, ...	2,569 80
	\$5,000 00

RECAPITULATION.
Regular Appropriations.

	Appropriation.	Expended.
For the Division of Administration, ...	\$28,700 00	\$25,219 35 ¹
For the Division of Hygiene, ...	27,850 00	28,016 18 ¹
For the Division of Communicable Diseases, ...	101,350 00	81,438 40 ¹
For antitoxin and vaccine lymph, ...	50,300 00	48,939 04 ¹
For the manufacture and distribution of arsphenamine, ...	19,200 00	12,647 91
For the Division of Food and Drug Inspection, ...	34,000 00	33,892 43 ¹
For the Division of Water Supply and Sewage Disposal, ...	66,000 00	63,976 29 ¹
For the State Examiners of Plumbers, ...	4,800 00	4,328 82
For an investigation relative to the causes of cancer, and for further investigations for the treatment or prevention of cancer.	3,000 00	1,198 46
Total, ...	\$335,200 00	\$299,656 88

Special Appropriations.

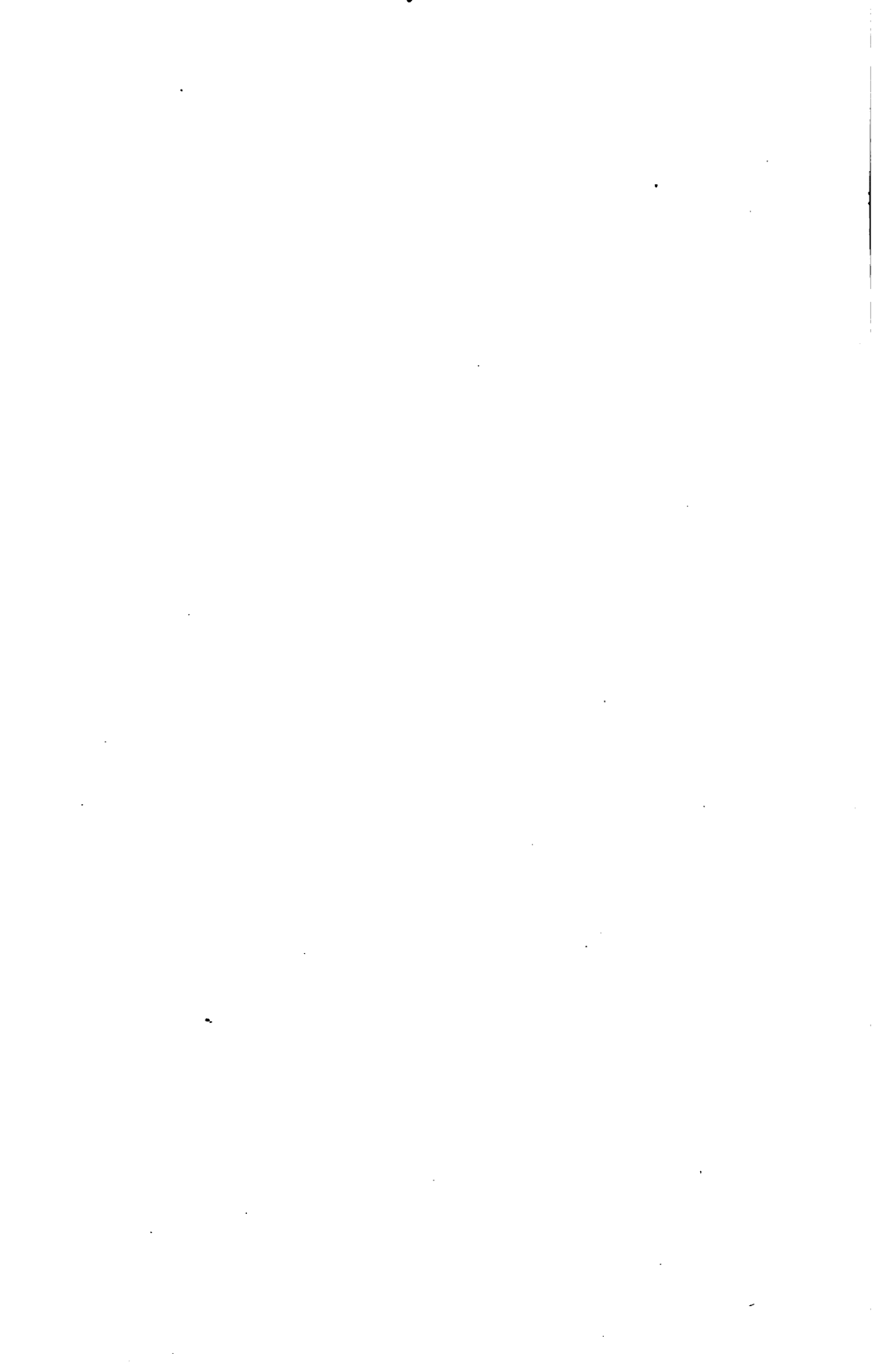
For the control, suppression and treatment of venereal diseases, balance from 1918.	\$10,490 01	\$11,550 64 ¹
For ascertaining the cost of a sewerage system to prevent the pollution of the Mystic Lakes.	500 00	413 00
Total, ...	\$10,990 01	\$11,963 64

Emergency Appropriations.

For work in connection with the epidemic of influenza-pneumonia, . . .	\$5,000 00	\$2,430 20
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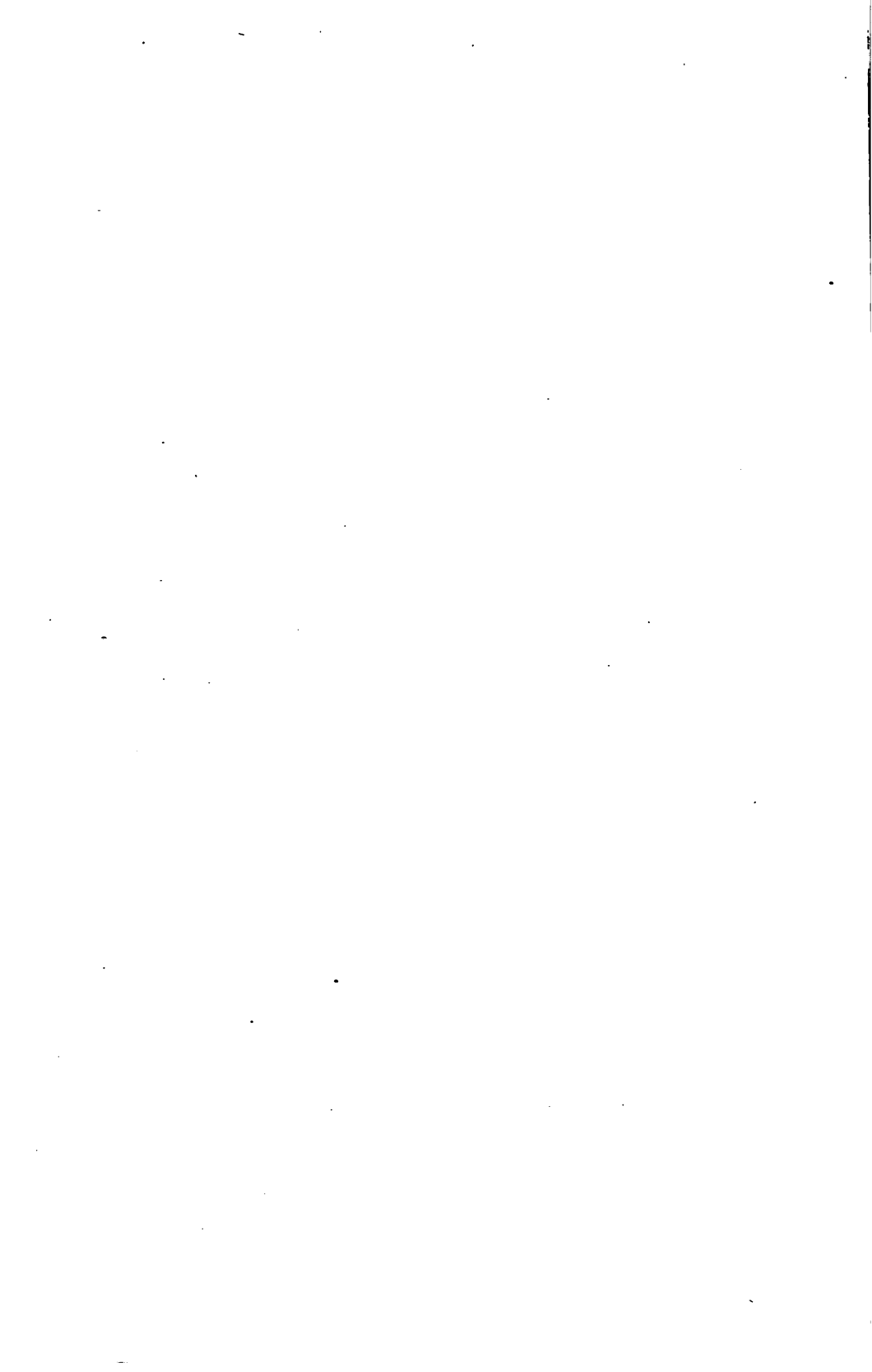
¹ Credits, cash returned to the State treasury and brought forward from 1918.

SUPPLEMENT



DIVISION OF SANITARY ENGINEERING

X. H. GOODNOUGH, *Director*



REPORT OF DIVISION OF SANITARY ENGINEERING.

The duties of this Division relate in general to the oversight and care of inland waters, including advice to cities, towns and persons relative to water supply, drainage, sewerage, sewage disposal and questions relating thereto. During the year 1919 the Department has received 146 applications for advice, of which 43 were in relation to public water supplies, 56 to private supplies, 4 to sources of ice supply, 19 to sewerage, drainage and sewage disposal, 6 to pollution of streams and 18 to miscellaneous matters.

As was the case during the years 1917 and 1918, very little permanent work relative to the introduction of new water supplies or the extension of old ones has been carried out during the year, such works as have been constructed being limited chiefly to cases of emergency, the high cost of materials and labor making construction work at the present time very costly. A number of investigations have been made, however, and plans prepared for the construction of new water works as soon as the conditions become more favorable for carrying on such construction at a reasonable cost.

The total number of cities and towns in the State is 354, of which 215 are provided with public water supplies. Many of the remaining towns are very small, with no considerable aggregation of population at any point, but there are still 21 towns, which had by the census of 1915 a population in excess of 2,000, in which the domestic water supply of the inhabitants is derived wholly from private wells. The Department has examined the private wells in many villages and towns where no public water supply exists, and in some cases has tested all of the wells in use. The results of these tests show that the wells in the populated districts of towns and villages are invariably affected in a greater or less degree by the sewage and other refuse deposited upon the ground in their neighborhood, and in some cases these wells are so grossly polluted as to be utterly unsafe for use for drinking. It is not practicable in such populous areas to obtain water of good quality, since numerous tests have shown that the ground waters beneath populous areas are very generally affected by sewage pollution, and that good waters cannot be obtained in such locations.

An important sanitary problem at the present time is that which

has been brought about by the development of lands for occupation by summer cottages and camps, the number of which is increasing very rapidly, not only along the seashore, but especially along the banks of rivers and the shores of lakes and ponds. In some of these communities lots are being laid out and occupied for camps and cottages which are so small in area that it is impracticable to locate a well upon them at any point within their limits at such a distance from a neighboring receptacle for sewage as to avoid danger of the pollution of the well. Such settlements as these are often remote from the thickly settled portions of the towns within which they are situated, and it is often impracticable for a town or a water company to provide a water supply in these communities and secure sufficient income therefrom to pay a reasonable return on the improvement and prevent such settlements from being a burden on the other water takers. Some of these settlements, however, are located in towns where no water supply has yet been introduced. Under such conditions the advantages of living in otherwise excellent surroundings may be more than offset by the use of an unsafe water supply and by objectionable methods of sewage disposal. In cases where it is practicable to extend public water supplies to such communities there is often hesitation to do so on the part of water departments, and especially of private companies, because complaint frequently arises on account of the necessity of charging for water, even though used for only a few weeks in summer, practically the same amount that would be charged for the entire year. The health authorities are attempting to meet this problem, which is becoming a most difficult one in many communities and can probably only be met, in some cases at least, by legislation. In the opinion of the Department the subject is one which should receive thorough investigation with a view to providing such legislation as may be necessary to prevent injury to the public health from such settlements, the number and size of which are rapidly increasing.

Early in the year, upon petition of the authorities of the city of Haverhill, the rules and regulations adopted for the sanitary protection of Lake Saltonstall were rescinded by the Department and the use of the lake as a source of water supply temporarily discontinued. Following the suspension of these protective rules it was reported that the use of the lake by the public resulted in gross abuses, and the Department was subsequently petitioned for the re-establishment of these regulations. The question of the further use of this source of water supply is still under investigation.

A regulation adopted by the Department providing that no permits should be granted for entering upon ponds and reservoirs used as

sources of water supply was rescinded in the spring of 1918, and the conditions affecting the granting of permits for boating, fishing, ice cutting, etc., on sources of water supply were restored to those existing before the war.

SANITARY PROTECTION OF PUBLIC WATER SUPPLIES.

Under the provisions of chapter 75, section 113, of the Revised Laws, as amended by chapter 467 of the Acts of 1907, this Department, at the request of municipal authorities, during the past year has adopted rules and regulations for the sanitary protection of the water supplies of the city of Leominster and the town of Dalton, and also for the protection of the water supply of the town of Lee, supplied by the Berkshire Water Company.

The following list shows the cities and towns in Massachusetts the water supplies of which are now protected by similar rules and regulations: —

Abington and Rockland.	Lincoln and Concord.
Amherst.	Lynn.
Andover.	Marlborough.
Attleboro.	Maynard.
Braintree.	Montague.
Brockton and Whitman.	Northampton.
Cambridge.	North Andover.
Chester.	Northborough.
Chicopee.	Norwood.
Concord.	Peabody.
Dalton.	Pittsfield.
Danvers and Middleton.	Plymouth.
Easthampton.	Randolph and Holbrook.
Fall River.	Rockport.
Falmouth.	Russell.
Fitchburg.	Rutland.
Gardner.	Salem and Beverly.
Great Barrington (Housatonic).	Springfield.
Greenfield.	Springfield and Ludlow.
Haverhill.	Stockbridge.
Hingham and Hull.	Taunton.
Holden.	Wakefield.
Holyoke.	Westfield.
Hudson.	West Springfield.
Lee.	Weymouth.
Leicester (Cherry Valley and Rochdale).	Williamsburg.
Leominster.	Winchester.
	Worcester.

WORK REQUIRED BY SPECIAL LEGISLATION.

Under the legislation of 1919 extra work was committed to this Department in connection with special investigations under the following resolves of the Legislature: Mystic Lakes (chapter 34, Resolves of 1918, and chapter 14, Resolves of 1919); Taunton River (chapter 29, Resolves of 1919); Blackstone River (chapter 15, Resolves of 1919); and Charles River (chapter 9, Resolves of 1919).

The engineering work in connection with the foregoing matters has been carried out by the Engineering Division.

Under the provisions of chapter 49 of the Resolves of 1919 the Metropolitan Water and Sewerage Board and the State Department of Health, acting jointly, are directed to investigate the water supply needs and resources of the Commonwealth, and under this act the Joint Board was organized in July as follows: —

Chairman, Dr. Henry P. Walcott, chairman, Metropolitan Water and Sewerage Board.

Chief engineer and secretary, X. H. Goodnough, chief engineer, State Department of Health.

Consulting engineer, Frederic P. Stearns, formerly chief engineer, Metropolitan Water and Sewerage Board.

The sudden death of Mr. Stearns on Dec. 1, 1919, removed from the staff the engineer who was most familiar with the construction and operation of the metropolitan water works, beginning with the first extensions which followed the introduction of water into Boston in 1848. Mr. Stearns not only served the State of Massachusetts in the construction of the great metropolitan water system, but had been consulting engineer in a large number of vast engineering projects, including the Panama Canal and the water supply of greater New York. His loss at this time deprives the Joint Board of the assistance of the expert best qualified to advise on the larger problems of water supply with which the State is now confronted.

At about the same time, following a general reorganization of the departments of the State, the chairman of the Joint Board, Dr. Henry P. Walcott, after long years of public labor, withdrew from the active service of the Commonwealth. As chairman of the State Board of Health which designed and recommended to the Legislature the metropolitan water system, and later as a member of the Metropolitan Water Board during the most of its existence, and its chairman for many years, Dr. Walcott possessed a remarkable and unique acquaintance with all the important problems of water supply affecting not merely the metropolitan district but all of the cities and

towns of the State, and his retirement is greatly regretted. These losses made necessary at the end of the year changes in the organization of the Joint Board.

The work has now been organized, and investigations are progressing at the present time as rapidly as practicable.

EXAMINATION OF PUBLIC WATER SUPPLIES.

The usual examinations of public water supplies have been carried on during the year, and many of the sources of supply have been inspected by the engineers of this Division. Chemical examinations of the various sources of supply have also been made as usual at intervals of from one to four months, and in a few cases bacterial tests have been made where such tests appeared necessary or desirable. On account of the heavy rainfall there has been no necessity for the use of auxiliary water supplies in emergencies, as commonly happens in dry seasons or in very cold winters.

Following are average results of chemical analyses of the sources examined in 1919.

ANALYSIS OF THE WATER OF PUBLIC WATER SUPPLIES.

Averages of Chemical Analyses of Surface-water Sources for the Year 1919.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	Hardness.
				Free.	ALBUMINOID.			
					Total.	Suspended.		
Metropolitan Water District.	Wachusett Reservoir, upper end,	.34	4.18	.0024	.0163	.0028	.30	1.1
	Wachusett Reservoir, lower end,	.14	3.39	.0020	.0127	.0019	.29	1.1
	Sudbury Reservoir, ...	.18	3.78	.0022	.0147	.0022	.33	1.4
	Framingham Reservoir, No. 3, .	.18	3.90	.0032	.0159	.0032	.35	1.3
	Hopkinton Reservoir, ...	.58	4.52	.0040	.0204	.0020	.39	1.3
	Ashland Reservoir, ...	.56	4.50	.0039	.0236	.0017	.36	1.3
	Framingham Reservoir No. 2, .	.79	5.66	.0060	.0265	.0025	.54	1.5
	Lake Cochituate, ...	.20	6.46	.0024	.0270	.0064	.70	2.7
	Chestnut Hill Reservoir, . . .	.17	3.90	.0024	.0137	.0025	.36	1.5
	Weston Reservoir, ...	.16	4.11	.0019	.0137	.0021	.33	1.4
	Spot Pond, ...	.09	3.79	.0020	.0152	.0023	.36	1.4
	Tap in State House, ...	.20	4.32	.0010	.0133	.0023	.36	1.5
	Tap in Revere, ...	.09	3.41	.0006	.0135	.0017	.34	1.4
	Tap in Quincy, ...	.16	3.94	.0009	.0111	.0013	.37	1.5

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	Hardness.
				Free.	ALBUMINOID.			
					Total.	Suspended.		
Abington, . . .	Big Sandy Pond, ...	.10	3.77	.0050	.0158	.0021	.71	1.2
Adams, ...	Dry Brook, ...	.21	7.07	.0016	.0095	.0011	.14	4.7
	Bassett Brook, ...	.04	3.66	.0013	.0043	.0004	.12	2.3
Amherst, . . .	Amethyst Brook large reservoir,	.49	3.60	.0023	.0120	.0016	.15	0.8
	Amethyst Brook small reservoir,	.21	3.00	.0029	.0121	.0022	.16	0.8
Andover, . . .	Haggett's Pond, ...	.15	4.35	.0027	.0189	.0044	.38	1.6
Ashburnham, .	Upper Naukeag Lake, ...	.12	2.42	.0012	.0076	.0009	.17	0.5
Ashfield, . . .	Bear Swamp Brook, ...	.28	5.47	.0023	.0136	.0015	.17	2.8
Athol, ...	Phillipston Reservoir, . . .	1.05	5.32	.0054	.0337	.0099	.22	1.2
	Buckman Brook Reservoir, . .	.30	3.55	.0023	.0201	.0069	.15	0.8
	Inlet of Filter, ...	.40	3.84	.0066	.0262	.0069	.16	1.0
	Outlet of Filter, ...	.45	4.48	.0045	.0215	-	.17	1.1
Barre, ...	Reservoir, ...	.15	3.87	.0023	.0139	.0016	.16	1.5
Blandford, . .	Freeland Brook, ...	.06	3.42	.0006	.0041	.0004	.23	1.5
Brockton, . . .	Silver Lake, ...	.13	3.50	.0016	.0134	.0022	.60	0.8
Cambridge, . .	Lower Hobbs Brook Reservoir, .	.20	6.11	.0060	.0238	.0026	.51	2.5
	Stony Brook Reservoir, . . .	.51	6.75	.0042	.0265	.0030	.57	2.5
	Fresh Pond, ...	.28	6.81	.0069	.0273	.0080	.61	2.9
Cheshire, . . .	Thunder Brook, ...	.01	6.65	.0002	.0050	.0004	.15	8.4
	Kitchen Brook, ...	.01	4.90	.0002	.0026	.0000	.14	5.1
Chicopee, . . .	Cooley Brook, ...	.74	3.74	.0053	.0165	.0041	.21	1.4
Colrain, ...	McClellan Reservoir, ...	.06	8.05	.0042	.0071	.0005	.17	5.2
Concord, . . .	Nagog Pond, ...	.09	2.74	.0013	.0124	.0015	.38	6.8
Dalton, ...	Egypt Brook Reservoir, . . .	.41	3.75	.0048	.0172	.0032	.19	2.6
	Cady Brook, ...	.33	5.22	.0016	.0167	.0021	.13	2.8
Danvers, . . .	Middleton Pond, ...	.49	5.11	.0061	.0240	.0038	.42	1.9
Deerfield (South), .	Roaring Brook, ...	.09	6.92	.0004	.0060	.0014	.16	4.3
Egremont (South),.	Goodale Brook, ...	.03	5.00	.0000	.0028	.0000	.14	3.3
Fall River, . . .	North Watuppa Lake, ...	.15	4.20	.0015	.0172	.0025	.61	1.0
Falmouth, . . .	Long Pond, ...	.03	3.49	.0016	.0121	.0014	1.10	0.6
Fitchburg, . . .	Meetinghouse Pond, ...	.10	2.98	.0032	.0180	.0018	.21	1.1
	Scott Reservoir, ...	.19	3.47	.0058	.0186	.0038	.23	0.7
	Wachusett Lake, ...	.11	3.02	.0046	.0166	.0026	.19	0.9
	Falulah Brook, ...	.22	3.34	.0041	.0152	.0026	.22	0.7

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	Hardness.
				Free.	ALBUMINOID.			
					Total.	Suspended.		
Fitchburg—Con.	Ashby Reservoir, ...	.35	3.26	.0112	.0265	.0036	.20	0.7
Gardner, . . .	Crystal Lake, ...	.12	4.51	.0021	.0168	.0033	.33	1.9
Gloucester, . .	Dike's Brook Reservoir, . .	.30	4.25	.0030	.0148	.0023	.74	0.5
	Wallace Reservoir, ...	.56	4.78	.0040	.0192	.0026	.89	0.5
	Haskell Brook Reservoir, . .	.19	3.79	.0011	.0122	.0017	.78	0.6
Great Barrington, .	East Mountain Reservoir, . .	.18	6.12	.0015	.0123	.0015	.12	4.0
	Green River, ...	.01	12.32	.0006	.0070	.0006	.13	10.2
Great Barrington (Housatonic).	Long Pond, ...	.08	9.20	.0033	.0190	.0027	.15	6.9
Greenfield, . .	Glen Brook Lower Reservoir, .	.05	5.75	.0012	.0082	.0014	.17	3.5
Hadley, . . .	Hart's Brook Reservoir, . .	.10	5.12	.0026	.0083	.0019	.16	2.2
Hatfield, . . .	Running Gutter Brook Reservoir,	.10	5.52	.0035	.0061	.0007	.21	2.8
Haverhill, . .	Johnson's Pond, ...	.15	4.87	.0019	.0174	.0016	.48	2.5
	Crystal Lake, ...	.19	3.55	.0019	.0175	.0013	.37	1.4
	Kenosha Lake, ...	.21	5.16	.0018	.0198	.0026	.43	2.5
	Lake Saltonstall, ...	.08	6.16	.0029	.0192	.0021	.63	3.1
	Lake Pentucket, ...	.15	4.96	.0024	.0212	.0035	.47	2.4
	Millvale Reservoir, ...	.60	5.62	.0031	.0198	.0024	.38	2.1
Hingham, . . .	Accord Pond, ...	.26	3.64	.0016	.0156	.0027	.54	0.5
Hinsdale, . . .	Reservoir, ...	.25	3.02	.0012	.0145	.0029	.10	0.8
Holyoke, . . .	Whiting Street Reservoir, . .	.13	5.14	.0043	.0157	.0020	.22	2.9
	Fomer Reservoir, ...	.35	4.23	.0046	.0152	.0019	.17	1.7
	Wright and Ashley Pond, . .	.11	5.48	.0045	.0134	.0028	.19	2.8
	High Service Reservoir, . . .	.11	4.19	.0041	.0181	.0032	.21	2.0
	White Reservoir, ...	.24	4.10	.0070	.0195	.0038	.19	1.7
Hudson, . . .	Gates Pond, ...	.07	3.34	.0026	.0182	.0044	.26	1.4
Huntington, . .	Cold Brook Reservoir, . . .	.16	3.65	.0002	.0078	.0010	.18	1.7
Ipswich, . . .	Dow's Brook Reservoir, . . .	.27	5.75	.0042	.0175	.0022	.69	1.9
Lawrence, . . .	Merrimack River, filtered, . .	.40	6.06	.0047	.0072	-	.48	1.1
Lee, ...	Codding Brook Upper Reservoir,	.15	4.58	.0010	.0074	.0004	.11	2.3
	Codding Brook Lower Reservoir,	.15	4.53	.0011	.0065	.0005	.13	2.4
	Basin Pond Brook, ...	.64	5.05	.0031	.0229	.0053	.13	1.6
Lenox, ...	Reservoir, ...	.09	7.81	.0006	.0060	.0004	.10	6.3
Leominster, . .	Morse Reservoir, ...	.20	2.74	.0056	.0171	.0021	.20	0.4
	Haynes Reservoir, ...	.29	2.96	.0232	.0274	.0069	.18	0.4

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	Hardness.
				Free.	ALBUMINOID.			
					Total.	Suspended.		
Leominster — Con. .	Fall Brook Reservoir, ...	.13	2.70	.0018	.0144	.0026	.20	0.6
Lincoln, ...	Sandy Pond, ...	.17	4.18	.0017	.0127	.0019	.34	1.4
Longmeadow, . .	Cooley Brook, ...	.07	5.49	.0044	.0067	.0011	.28	2.4
Lynn, ...	Birch Reservoir, ...	.21	5.36	.0094	.0203	.0032	.75	2.0
	Breed's Reservoir, ...	.42	5.94	.0081	.0230	.0036	.68	2.0
	Walden Reservoir, ...	.56	6.02	.0074	.0212	.0025	.70	2.0
	Hawkes Reservoir, ...	.52	6.18	.0088	.0241	.0047	.64	2.3
Manchester, . . .	Gravel Pond, ...	.13	4.45	.0022	.0150	.0023	.86	1.1
Marlborough, . .	Lake Williams, ...	.13	5.69	.0020	.0172	.0015	.56	2.2
	Millham Brook Reservoir, . . .	.49	5.34	.0065	.0236	.0038	.41	1.7
Maynard, ...	White Pond, ...	.35	3.27	.0008	.0141	.0019	.30	1.3
Milford, ...	Charles River, filtered, . . .	.22	5.27	.0008	.0072	—	.34	2.4
Montague, ...	Lake Pleasant, ...	.07	3.40	.0012	.0129	.0028	.16	0.8
Nantucket, . . .	Wannacomet Pond, ...	.11	7.12	.0050	.0202	.0068	2.14	1.7
New Bedford, . .	Little Quittacas Pond, ...	.41	4.20	.0059	.0227	.0027	.56	1.1
	Great Quittacas Pond, ...	.52	4.51	.0048	.0225	.0023	.54	1.0
North Adams, . .	Notch Brook Reservoir, ...	.10	7.41	.0013	.0060	.0012	.11	5.7
	Beaman Reservoir, ...	.06	7.06	.0020	.0078	.0013	.11	5.2
Northampton, . .	Middle Reservoir, ...	.25	4.33	.0016	.0132	.0019	.18	1.9
	Mountain Street Reservoir, . .	.10	4.26	.0014	.0079	.0009	.17	1.9
North Andover, . .	Great Pond, ...	.13	4.93	.0022	.0188	.0009	.45	1.9
Northborough, . .	Lower Reservoir, ...	.76	4.90	.0041	.0259	.0042	.29	1.2
Northbridge, . . .	Cook Allen Reservoir, ...	.01	3.05	.0005	.0033	.0004	.23	0.7
North Brookfield, .	Doane Pond, ...	.43	4.12	.0079	.0296	.0078	.18	1.1
	North Pond, ...	.42	3.42	.0042	.0247	.0043	.16	1.0
Northfield, . . .	Reservoir, ...	.10	4.50	.0008	.0065	.0006	.13	1.5
Orange, ...	Reservoir, ...	.12	2.92	.0006	.0048	.0005	.13	1.0
Palmer, ...	Lower Reservoir, ...	.27	2.70	.0059	.0169	.0035	.18	1.1
Peabody, ...	Spring Pond, ...	.37	5.68	.0117	.0238	.0050	.82	2.3
	Suntaug Lake, ...	.10	5.68	.0086	.0209	.0019	1.13	3.5
Pittsfield, ...	Ashley Brook, ...	.20	5.49	.0025	.0137	.0014	.13	3.5
	Hathaway Brook, ...	.10	8.49	.0006	.0060	.0005	.14	7.2
	Sacket Brook, ...	.19	5.09	.0009	.0078	.0010	.13	4.8

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	Hardness.
				Free.	ALBUMINOID.			
					Total.	Suspended.		
Pittsfield — Con.	Farnham Reservoir, ...	.52	4.63	.0029	.0191	.0031	.16	1.9
Plymouth, . . .	Little South Pond, ...	.05	3.03	.0040	.0192	.0023	.66	0.3
	Great South Pond, ...	.02	3.16	.0032	.0158	.0024	.67	0.3
Randolph, . . .	Great Pond, ...	.48	4.30	.0023	.0181	.0019	.59	1.5
Rockport, . . .	Cape Pond, ...	.27	10.29	.0116	.0290	.0093	3.53	1.7
Russell, . . .	Black Brook, ...	.20	4.85	.0005	.0092	.0006	.17	1.7
Rutland, . . .	Muschopeage Lake, ...	.10	2.92	.0008	.0103	.0010	.30	0.9
Salem, . . .	Wenham Lake, ...	.37	7.53	.0106	.0221	.0034	.90	2.4
	Longham Reservoir, ...	1.07	7.25	.0157	.0372	.0090	.90	2.0
Shelburne, . . .	Fox Brook, ...	.04	6.13	.0003	.0051	.0001	.13	3.6
Southbridge, . . .	Hatchet Brook Reservoir No. 3,	.23	3.32	.0030	.0146	.0028	.19	0.8
	Hatchet Brook Reservoir No. 4,	.24	2.94	.0037	.0164	.0032	.19	0.7
South Hadley, . . .	Leaping Well Reservoir, . . .	.12	3.22	.0035	.0177	.0049	.20	0.8
	Buttery Brook Reservoir, . . .	.13	4.71	.0035	.0103	.0020	.36	1.3
Spencer, . . .	Shaw Pond, ...	.11	3.04	.0020	.0171	.0019	.20	0.9
Springfield, . . .	Westfield Little River, filtered, .	.19	3.69	.0008	.0082	-	.16	1.4
Stockbridge, . . .	Lake Averie, ...	.13	7.16	.0024	.0166	.0022	.13	5.2
Stoughton, . . .	Muddy Pond Brook, ...	.17	4.32	.0005	.0090	.0021	.36	0.8
Taunton, . . .	Assawompoett Pond, ...	.30	4.49	.0030	.0199	.0023	.51	0.8
	Elder's Pond, ...	.13	3.62	.0026	.0173	.0023	.50	0.9
Wakefield, . . .	Crystal Lake, ...	.18	5.89	.0090	.0259	.0036	.81	2.0
Wareham (Onset), .	Jonathan Pond, ...	.06	2.52	.0011	.0099	.0013	.65	0.3
Wayland, . . .	Snake Brook Reservoir, ...	.80	4.62	.0144	.0311	.0047	.33	1.6
Westfield, . . .	Montgomery Reservoir, ...	.39	3.12	.0033	.0179	.0030	.18	0.8
	Tillotson Brook Reservoir, . . .	.20	3.47	.0019	.0088	.0009	.21	0.8
West Springfield, .	Bear Hole Brook, filtered, . . .	.05	6.68	.0006	.0044	-	.22	4.4
Weymouth, . . .	Great Pond, ...	1.12	4.55	.0075	.0249	.0031	.46	0.7
Williamsburg, . . .	Reservoir, ...	.12	4.70	.0003	.0074	.0004	.18	2.5
Williamstown, . . .	Reservoirs, ...	.04	8.80	.0004	.0068	.0008	.10	7.4
Winchester, . . .	North Reservoir, ...	.08	3.99	.0019	.0152	.0026	.43	1.5
	South Reservoir, ...	.11	3.62	.0014	.0146	.0017	.39	1.5
	Middle Reservoir, ...	.13	3.37	.0024	.0232	.0045	.38	1.3
Worcester, . . .	Bottomly Reservoir, ...	.36	4.37	.0048	.0220	.0029	.29	1.6

Averages of Chemical Analyses of Surface-water Sources, etc. — Concluded.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	Hardness.
				Free.	ALBUMINOID.			
					Total.	Suspended.		
Worcester—Con.	Kent Reservoir, ...	.25	3.98	.0027	.0153	.0035	.27	1.2
	Leicester Reservoir, ...	.19	4.22	.0041	.0142	.0018	.25	1.3
	Mann Reservoir, ...	.20	4.70	.0053	.0167	.0029	.22	1.9
	Upper Holden Reservoir, ...	.14	3.57	.0020	.0127	.0023	.24	1.4
	Lower Holden Reservoir, ...	.15	3.81	.0028	.0133	.0011	.29	1.0

Averages of Chemical Analyses of Ground-water Sources for the Year 1919.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albu- minoid.		Nitrates.	Nitrites.		
Acton, ...	Tubular wells, ...	.00	8.92	.0003	.0022	.69	.1400	.0003	3.6	.008
Amesbury, ...	Tubular wells, ...	.29	16.24	.0034	.0057	.55	—	—	9.3	.212
Ashland, ...	Tubular wells, ...	.00	5.25	.0002	.0021	.42	—	—	1.7	.011
Attleboro, ...	Large wells, ...	.04	5.52	.0006	.0050	.59	.0105	.0002	2.1	.015
Avon, ...	Wells, ...	.00	6.32	.0009	.0024	.56	.2300	.0000	2.5	.007
Ayer, ...	Large well, ...	.02	7.60	.0009	.0029	.69	.0533	.0000	3.1	.020
	Tubular wells, ...	.07	5.90	.0009	.0033	.32	.0057	.0000	3.2	.039
Barnstable, ...	Tubular wells, ...	.00	4.80	.0009	.0021	1.15	—	—	0.8	.014
Bedford, ...	Large well, ...	.09	5.20	.0004	.0035	.34	—	—	2.0	.017
Billerica, ...	Tubular wells, ...	.15	8.13	.0015	.0060	.42	—	—	3.4	.047
Braintree, ...	Filter-gallery, ...	.34	7.47	.0014	.0169	.90	.1963	.0002	2.3	.023
Bridgewater, ...	Wells, ...	.00	5.56	.0003	.0021	.64	.0217	.0000	1.6	.014
Brookfield (East), ...	Tubular wells, ...	.00	4.40	.0003	.0022	.24	—	—	0.8	.014
Brookline, ...	Tubular wells and filter- gallery filtered.	.15	8.92	.0007	.0079	.77	.0209	.0000	4.0	.010
Canton, ...	Springdale well, ...	.09	5.58	.0009	.0072	.56	.0260	.0000	1.9	.011
	Well near Henry's Spring, ...	.15	5.42	.0007	.0052	.56	.0372	.0000	1.8	.009
Chelmsford (North), ...	Tubular wells, ...	.13	5.35	.0127	.0085	.50	.0545	.0001	1.9	.020
Chelmsford (Center), ...	Tubular wells, ...	.00	8.80	.0008	.0020	.69	.1667	.0006	3.3	.009

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Chicopee (Fairview),	Tubular wells, . . .	.10	5.75	.0003	.0017	.30	.0809	.0002	2.0	.065
Cohasset, . . .	Tubular wells No. 2, . . .	.16	14.68	.0006	.0103	1.93	.1883	.0002	6.0	.011
	Filtered water, . . .	.22	8.62	.0023	.0110	1.16	.0090	.0000	3.3	.026
Dedham, . . .	Large well and tubular wells, . . .	.10	9.97	.0009	.0061	1.05	.1183	.0001	4.1	.010
Deerfield (Fire District),	Wells, . . .	.00	5.80	.0000	.0020	.20	—	—	3.5	.015
Douglas, . . .	Tubular wells, . . .	.03	4.70	.0001	.0018	.38	.0380	.0000	1.7	.119
Dracut (Water Supply District),	Tubular wells, . . .	.02	7.70	.0005	.0026	.58	.1136	.0000	4.5	.021
Dracut (Collinsville),	Tubular wells, . . .	.06	5.87	.0006	.0049	.35	.0075	.0000	2.1	.065
Dudley, . . .	Tubular wells, . . .	.00	3.00	.0001	.0017	.24	—	—	1.1	.007
Duxbury, . . .	Tubular wells, . . .	.00	4.67	.0003	.0020	.80	—	—	0.5	.007
Easthampton, . . .	Tubular wells, . . .	.01	8.33	.0002	.0017	.15	.0180	.0000	3.9	.007
Easton, . . .	Well, . . .	.00	5.23	.0002	.0024	.55	.0429	.0000	1.8	.007
Edgartown, . . .	Large well, . . .	.00	3.85	.0000	.0009	.99	—	—	0.4	.005
Fairhaven, . . .	Tubular wells, . . .	.47	8.30	.0024	.0132	.98	.1500	.0000	2.9	.025
Foxborough, . . .	Tubular wells, . . .	.00	4.30	.0005	.0017	.49	.0350	.0000	1.9	.013
Framingham, . . .	Filter-gallery, . . .	.02	12.58	.0235	.0073	2.06	.0168	.0005	6.0	.010
Franklin, . . .	Tubular wells, . . .	.00	6.10	.0004	.0022	.61	.0250	.0000	2.0	.009
Grafton, . . .	Filter-gallery, . . .	.09	12.63	.0007	.0042	1.59	.1975	.0001	4.6	.012
Granville, . . .	Well, . . .	.05	—	.0005	.0030	.13	—	—	1.7	.026
Groton, . . .	Large well, . . .	.00	6.27	.0007	.0032	.22	.0043	.0000	3.4	.011
Groton (West Groton Water Supply District),	Tubular wells, . . .	.00	5.03	.0001	.0021	.19	.0057	.0001	3.0	.021
Hingham, . . .	Wells, . . .	.23	6.13	.0027	.0083	.74	—	—	1.9	.026
Holliston, . . .	Large well, . . .	.39	5.13	.0023	.0173	.35	.0073	.0000	1.5	.062
Hopkinton, . . .	Tubular wells, . . .	.00	13.97	.0006	.0031	1.19	.3200	.0001	6.0	.017
Kingston, . . .	Tubular wells, . . .	.00	4.75	.0007	.0022	.70	—	—	1.1	.005
Leicester, . . .	Wells, . . .	.05	5.70	.0001	.0037	.27	.0810	.0001	2.0	.049
Leicester (Cherry Valley and Rockdale Water Supply District),	Wells, . . .	.22	4.52	.0017	.0111	.29	—	—	2.2	.013
Littleton, . . .	Tubular wells, . . .	.00	5.27	.0002	.0015	.21	.0087	.0000	1.6	.006
Lowell, . . .	Boulevard wells (tubular),	.57	7.34	.0609	.0075	.49	.0182	.0002	3.0	.443
	Boulevard wells (filtered),	.09	6.35	.0006	.0050	.49	.0392	.0000	2.4	.022
Manchester, . . .	Wells, . . .	.00	11.60	.0001	.0016	1.99	.1700	.0000	4.0	.020
Mansfield, . . .	Large well, . . .	.00	4.67	.0006	.0029	.42	.0952	.0000	2.0	.007

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albu- minoid.		Nitrates.	Nitrites.		
Marblehead, . . .	Wells, ...	16	15.68	.0008	.0065	2.72	.0110	.0000	6.8	.016
Marion, ...	Tubular wells, ...	.01	4.85	.0001	.0020	.72	.0362	.0000	1.5	.008
Marshfield, . . .	Wells, ...	.00	60.25	.0002	.0024	23.90	.1140	.0002	12.3	.014
Mattapoisett, . .	Tubular wells, ...	.00	6.60	.0005	.0023	.94	.0470	.0000	2.2	.013
Medfield, ...	Spring, ...	.01	4.53	.0005	.0026	.35	.0100	.0000	1.8	.011
Medway, ...	Tubular wells, ...	.03	6.93	.0003	.0026	.57	.0273	.0000	2.7	.012
Merrimac, ...	Tubular wells, ...	.00	8.57	.0008	.0027	.51	.0110	.0000	3.3	.009
Methuen, ...	Tubular wells, ...	.31	8.27	.0009	.0088	.47	.0144	.0000	3.2	.145
Middleborough, .	Well, ...	—	7.83	.0088	.0080	.66	.0442	.0000	2.6	.628
	Filtered water, ...	.13	6.63	.0006	.0055	.63	.0327	.0000	2.4	.045
Millbury, ...	Well, ...	.00	4.13	.0003	.0043	.30	.0093	.0000	1.4	.006
Millis, ...	Spring, ...	.00	10.57	.0003	.0023	.81	.2800	.0000	4.7	.005
Monson, ...	Large well, ...	.13	4.12	.0001	.0038	.21	—	—	0.9	.011
Natick, ...	Large well, ...	.00	10.27	.0002	.0029	.84	.0182	.0000	4.7	.007
Needham, ...	Wells, ...	.01	7.15	.0005	.0029	.71	.0897	.0001	2.6	.015
	Hicks Spring, ...	.00	8.35	.0013	.0054	.82	.1800	.0000	2.8	.008
Newburyport, . .	Wells and Artichoke River filtered.	.15	7.09	.0011	.0130	.69	.0161	.0000	3.0	.044
Newton, ...	Tubular wells and filter- gallery.	.01	6.10	.0003	.0038	.49	.0512	.0000	2.6	.005
No. Attleborough, .	Wells, ...	.00	6.89	.0009	.0035	.53	.0267	.0001	2.5	.010
Norton, ...	Tubular wells, ...	.00	4.10	.0002	.0016	.37	—	—	1.4	.007
Norwood, ...	Tubular wells, ...	.17	9.26	.0024	.0068	.58	.0289	.0000	3.8	.102
Oak Bluffs, . . .	Springs, ...	.00	4.80	.0002	.0032	1.23	.0230	.0000	1.1	.009
Oxford, ...	Tubular wells, ...	.00	5.10	.0002	.0021	.37	.0497	.0000	1.9	.006
Palmer (Bondsville),	Tubular wells, ...	.00	5.70	.0008	.0021	.24	.0207	.0001	2.2	.013
Pepperell, ...	Tubular wells, ...	.01	3.25	.0001	.0019	.19	—	—	1.7	.010
Plainville, ...	Tubular wells, ...	.02	5.15	.0005	.0017	.38	.0000	.0000	2.4	.029
Provincetown, . .	Tubular wells in Truro, .	.03	11.74	.0001	.0014	4.76	—	—	2.9	.030
Reading, ...	Filter-gallery, ...	.82	11.05	.0177	.0177	1.62	.0077	.0001	2.7	.355
	Filtered water, ...	.22	17.17	.0006	.0067	1.03	.0072	.0001	7.2	.078
Salisbury, ...	Well, ...	.18	8.25	.0005	.0041	.61	—	—	4.2	.043
Scituate, ...	Tubular wells, ...	.00	17.27	.0003	.0020	3.26	.1720	.0000	5.8	.012
Sharon, ...	Well, ...	.00	14.42	.0008	.0021	2.18	.3120	.0000	6.4	.010
	Tubular wells, ...	.01	5.50	.0003	.0023	.50	.0222	.0000	2.1	.010

Averages of Chemical Analyses of Ground-water Sources, etc. — Concluded.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albu- minoid.		Nitrates.	Nitrites.		
Sheffield, . . .	Spring, ...	.00	3.60	.0003	.0033	.09	—	—	1.8	.009
Shirley, ...	Well, ...	.00	5.15	.0001	.0015	.50	.1525	.0000	1.5	.008
Shrewsbury, . .	Wells, ...	.00	5.27	.0002	.0024	.65	.0500	.0000	1.7	.007
South Hadley (Fire District No. 2).	Large well, ...	.05	4.85	.0003	.0029	.16	.0175	.0000	1.6	.005
Tisbury, ...	Well, ...	.00	3.60	.0001	.0019	.99	—	—	0.6	.011
Uxbridge, ...	Tubular wells, ...	.00	4.40	.0004	.0021	.50	.0417	.0000	1.7	.014
Walpole, ...	Tubular wells, ...	.00	5.00	.0001	.0019	.45	.0250	.0000	1.8	.008
Waltham, ...	Old well, ...	.16	8.86	.0044	.0048	.83	.0132	.0001	4.0	.068
	New well, ...	.01	7.85	.0010	.0052	.61	.0161	.0001	3.7	.008
Ware, ...	Wells, ...	.00	7.80	.0001	.0015	.52	.1600	.0000	2.7	.009
Wareham (Fire District).	Tubular wells, ...	.01	3.03	.0009	.0023	.58	—	—	0.5	.005
Warren (West), .	Large well, ...	.00	5.60	.0006	.0012	.22	—	—	2.4	.016
Webster, ...	Wells, ...	.01	4.50	.0006	.0035	.38	.0105	.0000	1.9	.035
Wellesley, . . .	Tubular wells, ...	.03	9.74	.0007	.0027	1.31	.0532	.0000	4.3	.016
	Well at Williams Spring, ...	.02	14.40	.0004	.0030	1.24	.5600	.0000	5.7	.008
	Filter-gallery, ...	.04	9.36	.0007	.0036	.95	.0967	.0000	3.9	.009
Westborough, . .	Filter basin, ...	.04	3.31	.0021	.0095	.28	—	—	1.2	.015
West Brookfield, .	Tubular wells, ...	.00	5.03	.0001	.0017	.29	.0567	.0000	1.4	.011
Westford, ...	Tubular wells, ...	.01	5.07	.0004	.0022	.21	—	—	2.2	.018
Weston, ...	Well, ...	.35	7.92	.0023	.0125	.57	.0158	.0000	3.4	.014
Winchendon, . .	Wells, ...	.11	3.91	.0010	.0029	.15	—	—	1.0	.104
Woburn, ...	Filter-gallery, ...	.00	11.89	.0015	.0051	1.61	.0257	.0001	5.8	.006
Worthington, . .	Springs, ...	.07	2.20	.0001	.0054	.10	—	—	0.9	.024
Wrentham, ...	Tubular wells, ...	.00	4.60	.0003	.0017	.38	.0257	.0000	1.4	.006

WATER SUPPLY STATISTICS.

During the year ending Nov. 30, 1919, no new water supplies were introduced in the cities and towns of Massachusetts, and very few extensions were made to existing supplies.

The town of Acushnet is now credited with being supplied in part with water from the city of New Bedford, mains connected with the supply of this city having been introduced in 1916. The town of

Monterey is also supplied to a certain extent, private works having been introduced in 1917. These two supplies are not shown in the report of this Department for the year 1918, and there are now, therefore, 215 cities and towns, including all of the 38 cities and 177 towns, of the 354 cities and towns in the State which are provided with public water supplies.

The following table shows the classification by population (census of 1915) of the cities and towns having and those not having public water supplies at the end of the year 1919:—

POPULATION, 1915.	Number of Places of Given Population having Public Water Supplies.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having Public Water Supplies.	Total Population of Places in Preceding Column.
Under 500, ...	2	720	38	12,550
500-999, ...	7	5,229	36	27,536
1,000-1,499, ...	21	27,759	24	29,589
1,500-1,999, ...	12	21,685	20	33,947
2,000-2,499, ...	18	40,206	9	19,615
2,500-2,999, ...	20	54,895	6	16,013
3,000-3,499, ...	6	19,928	3	9,920
3,500-3,999, ...	8	30,123	—	—
Above 4,000, ...	121	3,329,981	3	13,614
Totals, ...	215	3,530,526	139	162,784

The 215 cities and towns having public water supplies are also classified in the following table according to the dates when a fairly complete system of water supply was introduced.

YEARS.	Number of Public Water Supplies introduced.	YEARS.	Number of Public Water Supplies introduced.
Previous to 1850, ...	5	1890-1899, inclusive, ...	34
1850-1859, inclusive, ...	4	1900-1909, inclusive, ...	21
1860-1869, inclusive, ...	9	1910-1919, inclusive, ...	27
1870-1879, inclusive, ...	45	Total, ...	215
1880-1889, inclusive, ...	70		

An examination of the first table given above will show that, although but 61 per cent of the cities and towns in the State of Massachusetts are provided with public water supplies, the total

population of these places is equivalent to about 96 per cent of the total population of the State (census of 1915).

At the present time all cities and towns in the State having a population in excess of 5,000 — with the exception of the town of Tewksbury — are provided with public water supplies, and only 12 towns having a population in excess of 2,500 are not so provided. These towns are the following: —

TOWN.	Population, 1915.	TOWN.	Population, 1915.
Tewksbury, ...	5,265	Sutton, ...	2,829
Warren, ...	4,268	Seekonk, ...	2,767
Templeton, ...	4,081	Bourne, ...	2,672
Somerset, ...	3,377	Hanover, ...	2,666
Auburn, ...	3,281	Swansea, ...	2,558
Westport, ...	3,262	Wilbraham, ...	2,521

At the end of the year 1919 the water supplies in all of the cities in Massachusetts and in 134 of the towns were owned either by the city or town, or by a water supply or fire district. In 44 towns the works were owned by private companies. The following table gives the classification by population of the cities and towns which own their water works, and those which are supplied by private companies: —

POPULATION, 1915.	CITIES AND TOWNS OWNING WATER WORKS.		CITIES AND TOWNS SUPPLIED WITH WATER BY PRIVATE COMPANIES.	
	Number.	Total Population.	Number.	Total Population.
Under 1,000, ...	4	2,263	5	3,686
1,000-1,999, ...	23	33,846	10	15,598
2,000-2,999, ...	29	71,794	9	23,307
3,000-3,999, ...	8	28,942	6	21,109
4,000-4,999, ...	7	31,251	2	9,476
5,000-5,999, ...	16	88,166	3	16,117
6,000-6,999, ...	10	66,316	3	18,778
7,000-7,999, ...	7	52,937	—	—
Over 8,000, ...	67	2,979,893	6	67,047
Total, ...	171	3,355,408	44	175,118

The annual report of the State Department of Health for the year 1915 (pages 296-306) shows the population and valuation of all

cities and towns in Massachusetts in 1915, together with certain other information relative to the ownership of the water works and the date of their introduction.

CONSUMPTION OF WATER.

The consumption of water in the various cities and towns in which records of consumption are kept is shown in the following table. In towns used extensively as summer resorts large quantities of water used by summer visitors are credited to the permanent population of the town, making the consumption of water per capita larger than is actually the case. There is a number of cases also in which the consumption of water per person is greatly increased by the use of an excessive quantity of water for manufacturing or other purposes.

Consumption of Water in Various Cities and Towns in 1919.

CITY OR TOWN.	Esti- mated Popu- lation.	AVERAGE DAILY CONSUMPTION.		CITY OR TOWN.	Esti- mated Popu- lation.	AVERAGE DAILY CONSUMPTION.	
		Gallons.	Gallons per Inhabit- ant.			Gallons.	Gallons per Inhabit- ant.
Metropolitan Water District: ¹ —	1,267,080	120,593,500	95	Abington and Rock-land.	12,990	642,000	49
Arlington, . . .	17,530	1,085,700	62	Acushnet, . . .	2,943	42,400	14
Belmont, . . .	9,710	564,000	58	Agawam, . . .	5,398	93,700	17
Boston, . . .	804,140	89,652,400	111	Amesbury, . . .	7,462	613,900	82
Chelsea, . . .	48,840	3,158,400	65	Andover, . . .	8,520	598,000	70
Everett, . . .	41,610	2,886,700	69	Ashland, . . .	2,263	168,700	75
Lexington, . . .	6,020	389,200	65	Athol, . . .	10,781	751,700	70
Malden, . . .	53,150	2,682,800	50	Attleboro, . . .	20,292	1,137,400	56
Medford, . . .	35,860	1,688,500	47	Avon, . . .	2,285	85,000	37
Melrose, . . .	18,170	1,057,100	58	Ayer, . . .	2,765	222,400	80
Milton, . . .	9,450	401,300	42	Barnstable, . . .	5,250	139,000	26
Nahant, . . .	1,570	186,900	119	Bedford, . . .	1,472	43,300	29
Quincy, . . .	45,280	4,550,100	100	Beverly, . . .	26,406	1,497,400	57
Revere, . . .	30,640	1,780,700	58	Billerica, . . .	3,612	367,400	102
Somerville, . . .	94,800	6,541,500	69	Braintree, . . .	10,365	637,400	62
Stoneham, . . .	7,840	602,400	77	Bridgewater, . . .	10,735	204,500	19
Swampscott, . . .	8,160	570,900	70	Brockton, . . .	66,616	2,798,000	42
Watertown, . . .	19,140	2,002,900	105	Brookline, . . .	38,048	3,309,100	87
Winthrop, . . .	15,170	792,000	52	Cambridge, . . .	112,009	10,512,600	94

¹ Figures taken from Table No. 16 of the Nineteenth Annual Report of the Metropolitan Water and Sewerage Board.

Consumption of Water in Various Cities and Towns in 1919 — Continued.

CITY OR TOWN.	Esti- mated Popu- lation.	AVERAGE DAILY CONSUMPTION.		CITY OR TOWN.	Esti- mated Popu- lation.	AVERAGE DAILY CONSUMPTION.	
		Gallons.	Gallons per Inhabit- ant.			Gallons.	Gallons per Inhabit- ant.
Canton, . . .	6,284	438,600	70	Longmeadow, . .	2,340	86,900	37
Chelmsford, . .	5,320	115,900	22	LOWELL, . . .	111,803	6,711,700	60
Clinton, . . .	13,286	683,600	51	Ludlow, . . .	7,293	201,200	28
Concord, . . .	6,889	573,100	83	LYNN and Saugus, .	112,946	8,048,000	71
Danvers and Mid- dleton, . . .	14,044	1,402,900	100	Manchester, . .	3,163	369,000	117
Dedham, . . .	12,450	796,000	64	Mansfield, . . .	6,243	630,500	101
Draut, . . .	4,435	93,400	21	Marblehead, . .	7,820	594,900	76
Dudley, . . .	4,458	130,900	29	Marion, . . .	1,509	99,300	66
Duxbury, . . .	2,107	64,200	30	MARLBOROUGH, .	15,787	690,800	44
East Bridgewater, .	3,950	85,300	22	Mattapoisett, . .	1,447	58,500	40
East Longmeadow, .	2,248	28,300	13	Maynard, . . .	7,074	331,000	47
Easthampton, . .	10,902	781,100	70	Medway, . . .	2,966	113,500	38
Easton, . . .	5,004	194,700	39	Merrimac, . . .	2,020	113,300	56
Edgartown, . . .	1,344	103,300	77	METHUEN, . . .	16,054	800,000	50
Fairhaven, . . .	7,201	323,800	45	Middleborough, .	8,965	382,500	43
FALL RIVER, . .	129,188	5,907,000	46	Milford and Hope- dale, . . .	17,230	856,900	50
Falmouth, . . .	4,535	389,000	86	Millbury, . . .	5,739	311,100	54
FITCHBURG, . . .	41,120	4,321,400	105	Millis, . . .	1,476	71,900	49
Framingham, . . .	18,190	950,200	52	Nantucket, . . .	3,329	257,400	77
Franklin, . . .	7,079	341,100	48	Natick, . . .	12,121	616,900	51
Gardner, . . .	17,718	721,000	41	Needham, . . .	7,755	395,700	51
GLOUCESTER, . .	24,542	1,506,600	61	NEW BEDFORD, . .	119,901	9,579,900	80
Grafton, . . .	6,686	217,600	33	NEWBURYPORT, . .	15,601	1,250,900	80
Greenfield, . . .	14,371	1,497,400	104	NEWTON, . . .	45,759	3,488,400	76
Groton, . . .	2,475	102,200	41	North Andover, . .	6,298	364,000	58
HAVERHILL, . . .	53,718	5,729,000	107	North Attleborough,	9,267	406,400	44
Holliston, . . .	2,850	116,100	41	North Brookfield, .	2,845	217,800	77
HOLYOKE, . . .	63,285	6,713,000	106	Norton, . . .	2,621	192,300	73
Hudson, . . .	6,770	348,400	51	Norwood, . . .	13,347	1,085,800	81
Ipswich, . . .	6,668	337,500	51	Orange, . . .	5,457	148,000	27
Lancaster, . . .	2,682	79,200	30	PEABODY, . . .	20,948	3,721,900	178
LAWRENCE, . . .	93,753	4,430,600	47	Pepperell, . . .	2,748	153,400	56
Lenox, . . .	3,388	293,900	87	PITTSFIELD, . . .	45,596	5,318,280	117
Lincoln, . . .	1,418	216,700	153	Plymouth, . . .	13,564	1,330,900	98
Littleton, . . .	1,228	36,700	30	Provincetown, . .	4,236	300,700	71

Consumption of Water in Various Cities and Towns in 1919 — Concluded.

CITY OR TOWN.	Esti- mated Popu- lation.	AVERAGE DAILY CONSUMPTION.		CITY OR TOWN.	Esti- mated Popu- lation.	AVERAGE DAILY CONSUMPTION.	
		Gallons.	Gallons per Inhabit- ant.			Gallons.	Gallons per Inhabit- ant.
Randolph and Hol- brook.	8,134	453,900	56	Walpole, . . .	5,968	1,020,500	171
Reading, . . .	7,595	259,000	34	WALTHAM, . . .	32,010	1,952,100	61
Rockport, . . .	4,463	258,400	58	Wareham, . . .	6,035	163,800	27
SALEM, . . .	46,500	5,305,400	114	Webster, . . .	13,410	695,900	52
Salisbury, . . .	1,764	130,100	74	Wellesley, . . .	7,260	521,600	72
Scituate, . . .	2,804	320,300	114	West Brookfield, . . .	1,258	33,300	26
Sharon, . . .	2,594	193,100	74	Westfield, . . .	20,305	2,200,800	108
Shirley, . . .	2,341	89,400	38	Westford, . . .	2,837	152,100	54
Shrewsbury, . . .	3,472	93,100	27	Weston, . . .	2,531	132,100	52
Southbridge, . . .	15,517	864,500	56	Weymouth, . . .	14,828	1,207,900	81
SPRINGFIELD, . . .	114,207	11,920,000	104	Whitman, . . .	7,702	228,400	30
Stoughton, . . .	7,515	413,600	55	Winchester, . . .	10,562	444,000	42
TAUNTON, . . .	37,683	3,090,000	82	WOBURN, . . .	17,292	1,795,600	104
Tisbury, . . .	1,426	130,500	92	WORCESTER, . . .	178,066	14,723,000	84
Wakefield, . . .	13,883	579,100	42	Wrentham, . . .	2,951	84,000	28

RAINFALL.

The normal yearly rainfall in Massachusetts as deduced from long-continued observations in various parts of the State is 44.53 inches. The average rainfall for the year 1919 in these places was 45.83, an excess of 1.30 inches over the normal. This year was the first since 1903 in which the rainfall has been in excess of the normal. The accumulated deficiency for these sixteen years is 57.78, a quantity greater by 13.25 inches than the total rainfall in a normal year. There was an excess of precipitation in the months of March, May, July, August, September and November, and a deficiency in the other six months of the year. The greatest excess in any month occurred in September, when the average rainfall was 5.61 inches, or 2.13 inches greater than the normal, and the greatest deficiency occurred in June, when the average rainfall was 1.57 inches, or 1.66 inches less than the normal.

The following table gives the normal rainfall in the State for each month as deduced from observations at various places for a long

period of years, together with the average rainfall at those places for each month during the year 1919 and the departure from the normal:—

MONTH.	Normal Rainfall (Inches).	Rainfall in 1919 (Inches).	Excess or Deficiency in 1919 (Inches).	MONTH.	Normal Rainfall (Inches).	Rainfall in 1919 (Inches).	Excess or Deficiency in 1919 (Inches).
January, . .	3.76	3.49	—0.27	August, . .	4.22	4.95	+0.73
February, . .	3.66	3.19	—0.47	September, . .	3.48	5.61	+2.13
March, . .	3.95	4.68	+0.73	October, . .	3.77	2.38	—1.39
April, . .	3.58	2.94	—0.64	November, . .	3.81	5.45	+1.64
May, . .	3.65	5.45	+1.80	December, . .	3.66	2.05	—1.61
June, . .	3.23	1.57	—1.66	Totals, . .	44.53	45.83	+1.30
July, . .	3.76	4.07	+0.31				

FLOW OF STREAMS.

Sudbury River.

The average flow of the Sudbury River during the year 1919 was 988,000 gallons per day per square mile of drainage area, or about 1 per cent in excess of the normal flow for the past forty-five years. The flow was above the normal in the months of January, March, May, July, September, November and December, but less than the normal in the other five months of the year. The greatest excess occurred in the month of November, and the greatest deficiency in the month of February. The average flow for the driest six months, June to November, inclusive, was 458,000 gallons per day per square mile, or about 21 per cent in excess of the normal flow for that period during the past forty-five years.

In order to show the relation between the flow of the Sudbury River during each month of the year 1919 and the normal flow of that stream as deduced from observations during forty-five years, from 1875 to 1919, inclusive, the following table has been prepared. The drainage area of the Sudbury River above the point of measurement is 75.2 square miles.

Table showing the Average Daily Flow of the Sudbury River for Each Month in the Year 1919, in Cubic Feet per Second per Square Mile of drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

MONTH.	NORMAL FLOW.		ACTUAL FLOW IN 1919.		EXCESS OR DEFICIENCY.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January, ...	1.789	1.157	2.021	1.306	+ .232	+ .149
February, ...	2.540	1.642	1.418	.917	-1.122	-.725
March, ...	4.160	2.689	4.270	2.759	+ .110	+ .070
April, ...	3.046	1.969	2.651	1.713	- .395	-.256
May, ...	1.653	1.069	1.996	1.290	+ .343	+ .221
June, ...	.746	.462	.174	.112	- .572	-.370
July, ...	.281	.182	.463	.299	+ .182	+ .117
August, ...	.360	.233	.143	.092	- .217	-.141
September, ...	.361	.233	1.108	.713	+ .742	+ .480
October, ...	.629	.407	.431	.279	- .198	-.128
November, ...	1.136	.735	1.973	1.275	+ .837	+ .540
December, ...	1.467	.948	1.694	1.095	+ .227	+ .147
Average for whole year,	1.509	.975	1.529	.968	+ .020	+ .013

In the annual report of the State Department of Health for the year 1915 (pages 312 to 318) tables were presented giving the record of the rainfall upon the drainage area of the Sudbury River and the yield expressed in inches in depth upon the drainage area (inches of rainfall collected) for each of the forty-one years from 1875 to 1915, inclusive. The corresponding record for the years 1916 to 1919, inclusive, together with the average for the entire period of forty-five years, is given in the following table: —

Rainfall, in Inches, received and collected on the Sudbury River Drainage Area.

MONTH.	1916.			1917.			1918.		
	Rain-fall.	Rain-fall col-lected.	Per Cent col-lected.	Rain-fall.	Rain-fall col-lected.	Per Cent col-lected.	Rain-fall.	Rain-fall col-lected.	Per Cent col-lected.
January, ...	1.53	1.680	109.8	3.50	.909	25.9	3.47	.486	14.0
February, ...	5.91	2.262	38.2	2.68	1.216	45.5	3.58	2.914	81.3
March, ...	4.16	3.245	78.1	4.96	3.940	79.4	2.50	3.896	156.2
April, ...	4.19	5.243	125.1	2.41	2.425	100.5	4.43	2.530	57.1
May, ...	3.43	2.567	74.9	4.93	2.632	53.4	1.16	1.141	98.8
June, ...	4.77	2.068	43.4	4.23	1.802	42.7	3.65	.319	8.7
July, ...	5.17	1.044	20.2	1.11	.076	6.8	4.07	.171	4.2
August, ...	2.01	.139	6.9	6.40	.361	5.6	1.61	— .096	— 6.0
September, ...	1.80	.044	2.5	1.52	.100	6.6	8.60	1.100	12.8
October, ...	1.49	— .009	— .6	5.65	.860	15.2	1.04	.490	47.0
November, ...	2.28	.189	8.3	1.31	.757	57.6	2.75	.843	30.7
December, ...	3.22	.562	17.4	2.81	.678	24.2	3.68	1.673	45.5
Totals and averages, .	39.96	19.034	47.6	41.51	15.756	38.0	40.54	15.467	38.2

MONTH.	1919.			MEAN FOR FORTY-FIVE YEARS, 1875-1919.		
	Rainfall.	Rainfall collected.	Per Cent collected.	Rainfall.	Rainfall collected.	Per Cent collected.
January, ...	3.52	2.329	66.1	4.03	2.063	51.1
February, ...	3.40	1.477	43.4	4.10	2.666	65.0
March, ...	4.79	4.916	102.7	4.33	4.796	110.7
April, ...	2.93	2.957	101.0	3.55	3.400	95.9
May, ...	4.60	2.301	50.0	3.30	1.907	57.7
June, ...	1.86	.193	10.4	3.08	.833	27.1
July, ...	5.47	.533	9.8	3.68	.324	8.8
August, ...	3.75	.164	4.4	3.86	.415	10.8
September, ...	5.28	1.232	23.3	3.41	.403	11.8
October, ...	2.16	.498	23.1	3.73	.725	19.4
November, ...	5.90	2.202	37.3	3.70	1.268	34.3
December, ...	1.98	1.952	98.6	3.76	1.692	45.0
Totals and averages, .	45.64	20.754	45.5	44.53	20.492	46.0

The following table gives the record of the yield of the drainage area of the Sudbury River for each of the last four years, the flow being expressed in gallons per day per square mile of drainage area in order to render the table more convenient for use in estimating the probable yield of drainage areas used as sources of water supply:—

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile.¹

MONTH.	1916.	1917.	1918.	1919.	Mean for Forty-five Years, 1875-1919.
January, ...	942,000	510,000	273,000	1,306,000	1,157,000
February, ...	1,356,000	755,000	1,809,000	917,000	1,642,000
March, ...	1,820,000	2,209,000	2,187,000	2,759,000	2,689,000
April, ...	3,037,000	1,405,000	1,466,000	1,713,000	1,969,000
May, ...	1,439,000	1,476,000	639,000	1,290,000	1,069,000
June, ...	1,198,000	1,044,000	185,000	112,000	482,000
July, ...	585,000	43,000	96,000	299,000	182,000
August, ...	78,000	202,000	—54,000	92,000	233,000
September, ...	26,000	58,000	637,000	713,000	233,000
October, ...	—5,000	482,000	274,000	279,000	407,000
November, ...	110,000	438,000	489,000	1,275,000	735,000
December, ...	315,000	380,000	938,000	1,095,000	948,000
Average for whole year, . . .	904,000	750,000	736,000	968,000	975,000
Average for driest six months, .	186,000	267,000	269,000	458,000	377,000

¹ The drainage area of the Sudbury River used in making up these records included water surfaces amounting to about 2 per cent of the whole area, from 1875 to 1878, inclusive, subsequently increasing by the construction of storage reservoirs to about 3 per cent in 1879, to 3.5 per cent in 1885, to 4 per cent in 1894 and to 6.5 per cent in 1898. The drainage area also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Nashua River.

The average flow of the South Branch of the Nashua River at the outlet of the Wachusett Reservoir, Clinton, during the year 1919 was 1,257,000 gallons per day per square mile of drainage area, or 18 per cent in excess of the normal flow for the past twenty-three years. The flow was greater than the normal in the months of January, March, May, September, October, November and December, and less than the normal in the other five months of the year. The greatest excess occurred in the month of November, and the greatest deficiency in the month of February. The average flow for the driest six months, June to November, inclusive, was 752,000 gallons

per day per square mile, or about 41 per cent in excess of the normal flow for that period during the past twenty-three years.

In order to show the relation between the flow of the Nashua River during each month of the year 1919 and the normal flow of that stream as deduced from observations during twenty-three years, 1897 to 1919, inclusive, the following table has been prepared. The drainage area of the Nashua River above the point of measurement was 119 square miles from 1897 to 1907, and 118.19 square miles from 1908 to 1913, inclusive. Since Jan. 1, 1914, the city of Worcester has been diverting water from 9.35 square miles of this drainage area for the supply of that city, leaving the net drainage area 108.84 square miles. In the calculations of yield allowance has been made for water overflowing from the Worcester area.

Table showing the Average Daily Flow of the South Branch of the Nashua River for Each Month in the Year 1919, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also Departure from the Normal Flow.

• MONTH.	NORMAL FLOW.		ACTUAL FLOW IN 1919.		EXCESS OR DEFICIENCY.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January, ...	1.832	1.184	2.075	1.341	+ .243	+ .157
February, ...	2.150	1.389	1.228	.794	— .922	— .595
March, ...	3.987	2.577	4.882	3.155	+ .895	+ .578
April, ...	3.245	2.097	2.648	1.711	— .597	— .386
May, ...	1.893	1.223	3.410	2.204	+1.517	+ .981
June, ...	1.182	.764	.715	.462	— .467	— .302
July, ...	.661	.427	.619	.400	— .042	— .027
August, ...	.633	.409	.405	.262	— .228	— .147
September, ...	.560	.362	1.691	1.093	+1.131	+ .731
October, ...	.747	.483	.765	.495	+ .018	+ .012
November, ...	1.167	.755	2.840	1.835	+1.673	+1.080
December, ...	1.720	1.112	1.999	1.292	+ .279	+ .180
Average for whole year,	1.646	1.063	1.945	1.257	+ .299	+ .194

In the annual report of the State Department of Health for the year 1915 (pages 324 to 327) tables were presented giving the record of the rainfall upon the drainage area of the Nashua River, and the total yield expressed in inches in depth upon the drainage area (inches of rainfall collected) for each of the nineteen years from 1897

to 1915, inclusive. The corresponding record for the years 1916 to 1919, inclusive, together with the average for the entire period of twenty-three years, is given in the following table:—

Rainfall, in Inches, received and collected on the Nashua River Drainage Area.

MONTH.	1916.			1917.			1918.		
	Rain-fall.	Rain-fall collected.	Per Cent collected.	Rain-fall.	Rain-fall collected.	Per Cent collected.	Rain-fall.	Rain-fall collected.	Per Cent collected.
January, ...	1.60	2.346	146.7	3.37	1.224	36.3	2.97	.864	29.1
February, ...	5.98	3.030	50.7	3.05	1.476	48.3	4.25	3.260	76.6
March, ...	3.32	3.374	101.5	4.21	4.409	104.8	2.24	4.614	206.0
April, ...	3.65	5.696	156.0	1.80	2.535	140.6	3.47	2.775	80.0
May, ...	3.34	3.028	90.7	3.89	2.350	60.5	1.07	1.201	112.8
June, ...	6.57	3.546	53.9	4.47	2.122	47.4	4.57	.902	19.8
July, ...	5.66	1.937	34.2	1.22	.471	38.8	2.80	.499	17.8
August, ...	1.72	.506	29.5	4.46	.552	12.4	2.82	.284	10.1
September, ...	4.21	.506	12.0	1.20	.144	12.0	7.18	1.041	14.5
October, ...	1.42	.250	17.6	6.03	.990	16.4	1.58	.609	38.6
November, ...	3.15	.554	17.6	1.25	.540	43.1	3.08	1.004	32.6
December, ...	2.81	.820	29.2	2.31	.694	30.0	3.74	1.884	50.4
Totals and averages, .	43.43	25.593	58.9	37.26	17.507	47.0	39.77	18.937	47.6

MONTH.	1919.			MEAN FOR TWENTY-THREE YEARS 1897-1919.		
	Rainfall.	Rainfall collected.	Per Cent collected.	Rainfall.	Rainfall collected.	Per Cent collected.
January, ...	3.23	2.392	74.1	3.61	2.113	58.6
February, ...	3.51	1.279	36.5	3.79	2.251	59.4
March, ...	5.27	5.621	106.7	4.08	4.595	112.5
April, ...	2.57	2.954	115.0	3.65	3.620	99.0
May, ...	6.06	3.931	64.9	3.40	2.183	64.2
June, ...	2.01	.798	39.6	3.68	1.319	35.8
July, ...	5.00	.713	14.3	4.08	.763	18.7
August, ...	4.17	.467	11.2	4.14	.730	17.7
September, ...	6.78	1.887	27.8	3.73	.625	16.8
October, ...	2.35	.884	37.6	3.34	.861	25.8
November, ...	6.01	3.168	52.7	3.39	1.302	38.4
December, ...	2.09	2.305	110.4	3.98	1.983	49.9
Totals and averages, .	49.05	26.399	53.8	44.87	22.345	49.8

The following table gives a record of the yield of the drainage area of the Nashua River for each of the last four years, the flow being expressed in gallons per day per square mile of drainage area:—

Yield of the Nashua River Drainage Area in Gallons per Day per Square Mile.¹

MONTH.	1916.	1917.	1918.	1919.	Mean for Twenty- three Years, 1897-1919.
January, ...	1,315,000	686,000	484,000	1,341,000	1,184,000
February, ...	1,816,000	916,000	2,024,000	794,000	1,389,000
March, ...	1,891,000	2,472,000	2,590,000	3,155,000	2,577,000
April, ...	3,300,000	1,468,000	1,608,000	1,711,000	2,097,000
May, ...	1,697,000	1,317,000	673,000	2,204,000	1,223,000
June, ...	2,054,000	1,229,000	523,000	462,000	764,000
July, ...	1,088,000	264,000	280,000	400,000	427,000
August, ...	284,000	309,000	159,000	262,000	409,000
September, ...	294,000	84,000	603,000	1,093,000	362,000
October, ...	140,000	555,000	341,000	495,000	483,000
November, ...	321,000	313,000	582,000	1,835,000	755,000
December, ...	460,000	389,000	1,056,000	1,292,000	1,112,000
Average for whole year, . .	1,215,000	834,000	902,000	1,257,000	1,063,000
Average for driest six months, .	432,000	320,000	412,000	752,000	533,000

¹ The drainage area used in making up these records included water surfaces amounting to 2.2 per cent of the whole area from 1897 to 1902, inclusive, to 2.4 per cent in 1903, to 3.6 per cent in 1904, to 4.1 per cent in 1906, to 5.1 per cent in 1906, to 6 per cent in 1907, to 7 per cent in 1908, 1909 and 1910, to 6.5 per cent in 1911, to 6.8 per cent in 1912, to 7 per cent in 1913, to 7.4 per cent in 1914 and 1915, to 7.6 per cent in 1916, to 7.4 per cent in 1917 and 1918, and to 7.5 per cent in 1919.

Merrimack River.

The flow of the Merrimack River has been measured for many years at Lawrence, where the river has a total drainage area of 4,663 square miles, which includes 118¹ square miles on the South Branch of the Nashua River, 75 square miles on the Sudbury River and 18 square miles tributary to Lake Cochituate, or a combined area of 211¹ square miles from which water is drawn at the present time for the supply of the Metropolitan Water District. The flow as measured at Lawrence includes the water wasted from these three drainage areas, the aggregate quantity of which, in the wet months of the year, is considerable, but which becomes very small in the dry months. Records of the quantity of water wasted have been kept by the Boston Water

¹ Including 9.35 square miles from which water is drawn for the supply of the city of Worcester.

Board and by the Metropolitan Water and Sewerage Board, and these quantities have been deducted from the flow as measured at Lawrence. In presenting the record of the flow of the river, these three drainage areas have been deducted from the total above Lawrence, so that the net drainage area above that point was 4,567 square miles in 1880, 4,570 square miles in the years 1881 to 1897, inclusive, and 4,452 square miles since the latter year.

The average flow of the Merrimack River during the year 1919 amounted to 1.427 cubic feet per second, or 923,000 gallons per day, per square mile of drainage area, or 98 per cent of the normal flow for the past forty years for which records are available. The flow was in excess of the normal in the months of January, March, May, September, November and December, and less than the normal in the other six months of the year.

In order to show the relation between the flow of this stream during each month of the year 1919 and the normal flow as deduced from observations during the forty years from 1880 to 1919, inclusive, the following table has been prepared:—

Table showing the Average Monthly Flow of the Merrimack River at Lawrence for the Year 1919 in Cubic Feet per Second per Square Mile of Drainage Area; also the Departure from the Normal Flow.

MONTH.	Normal Flow, 1880-1919.	Actual Flow in 1919.	Excess or Deficiency.
January, ...	1.285	1.314	+0.029
February, ...	1.401	.872	-0.529
March, ...	2.713	3.383	+0.670
April, ...	3.393	2.542	-0.851
May, ...	2.185	2.741	+0.556
June, ...	1.258	1.007	-0.251
July, ...	.741	.539	-0.202
August, ...	.677	.401	-0.276
September, ...	.651	.653	+0.002
October, ...	.808	.699	-0.109
November, ...	1.122	1.648	+0.526
December, ...	1.219	1.331	+0.112
Average for whole year, ...	1.454	1.427	-0.027

The following table gives the record of the flow of the Merrimack River at Lawrence for each of the last four years, the flow being expressed in cubic feet per second per square mile of net drainage area: —

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile.

MONTH.	1916.	1917.	1918.	1919.	Mean for Forty Years, 1880-1919.
January, ...	1.527	1.023	.466	1.314	1.285
February, ...	1.674	.770	.819	.872	1.401
March, ...	1.735	2.316	1.983	3.383	2.713
April, ...	4.323	3.242	3.337	2.542	3.393
May, ...	2.733	2.124	1.540	2.741	2.185
June, ...	3.101	3.037	.757	1.007	1.258
July, ...	1.531	1.024	.553	.539	.741
August, ...	.924	.629	.470	.401	.677
September, ...	.972	.549	.847	.653	.651
October, ...	.798	.613	.991	.699	.808
November, ...	.743	.882	1.126	1.648	1.122
December, ...	1.154	.569	1.492	1.331	1.219
Average for whole year, . . .	1.768	1.398	1.198	1.427	1.454
Average for driest six months, .	1.020	.711	.791	.825	.870

Sudbury, Nashua and Merrimack Rivers.

The following table shows the weekly fluctuations during the year 1919 in the flow of the three streams just described, namely, the Sudbury River at Framingham, the South Branch of the Nashua River above Clinton, and the Merrimack River at Lawrence. The flow of the first two serves to indicate the flow of other streams in eastern Massachusetts, while that of the Merrimack indicates the general stream flow in central New England.

Table showing the Average Weekly Flow of the Sudbury, South Branch of the Nashua and the Merrimack Rivers for the year 1919 in Cubic Feet per Second per Square Mile of Drainage Area.

WEEK ENDING SUNDAY —	FLOW IN CUBIC FEET PER SECOND PER SQUARE MILE.			WEEK ENDING SUNDAY —	FLOW IN CUBIC FEET PER SECOND PER SQUARE MILE.		
	Sudbury River.	South Branch Nashua River.	Merrimack River.		Sudbury River.	South Branch Nashua River.	Merrimack River.
Jan. 5, . . .	2.393	2.515	1.367	July 6, . . .	.098	.498	.571
12, . . .	1.543	1.274	1.183	13, . . .	.014	.378	.573
19, . . .	.643	1.099	.937	20, . . .	.565	.894	.482
26, . . .	3.123	3.382	1.436	27, . . .	1.205	.887	.548
Feb. 2, . . .	1.681	1.607	1.620	Aug. 3, . . .	.182	.105	.477
9, . . .	.913	.951	.974	10, . . .	.128	.128	.419
16, . . .	1.018	1.068	.780	17, . . .	.021	.156	.379
23, . . .	.985	1.191	.706	24, . . .	— .046	.936	.426
Mar. 2, . . .	4.498	2.893	1.152	31, . . .	.475	.583	.417
9, . . .	3.550	4.329	2.652	Sept. 7, . . .	1.435	2.945	.472
16, . . .	3.937	3.376	2.880	14, . . .	1.673	1.956	.773
23, . . .	5.054	5.120	3.290	21, . . .	.745	.760	.753
30, . . .	3.772	5.331	4.837	28, . . .	.817	1.411	.576
Apr. 6, . . .	2.972	2.950	3.522	Oct. 5, . . .	.282	.611	.555
13, . . .	2.482	2.636	2.498	12, . . .	.320	.616	.693
20, . . .	3.996	3.970	2.955	19, . . .	.591	.810	.681
27, . . .	2.080	1.727	2.100	26, . . .	.223	.618	.732
May 4, . . .	1.614	2.175	1.691	Nov. 2, . . .	1.135	1.950	.932
11, . . .	1.593	2.650	1.906	9, . . .	2.221	2.892	1.850
18, . . .	2.875	3.527	2.074	16, . . .	1.245	2.243	1.883
25, . . .	2.394	5.548	4.349	23, . . .	.980	1.290	1.326
June 1, . . .	1.093	2.000	2.979	30, . . .	3.252	4.711	1.727
8, . . .	.365	.948	1.302	Dec. 7, . . .	2.258	2.021	1.843
15, . . .	.025	.772	1.208	14, . . .	2.952	3.677	1.637
22, . . .	— .031	.444	.816	21, . . .	1.472	1.384	1.229
29, . . .	.341	.685	.620	28, . . .	.787	1.282	.797

EXAMINATION OF RIVERS.

The condition of the various rivers was examined as usual during the year, and a summary of the results was presented in the preliminary report to the Legislature dated Jan. 10, 1920, and published as House Document No. 873.

In addition to this report special reports were presented with regard to the Charles, Taunton and Blackstone rivers by direction of resolves of the Legislature of 1919. The report upon the Charles River was made under the direction of chapter 9 of the Resolves of 1919, was presented on Jan. 10, 1920, and is published as House Document No. 1240; the report upon the Taunton River was made by direction of chapter 29 of the Resolves of 1919, was presented on Jan. 7, 1920, and is published as House Document No. 1115; the report on the Blackstone River was made by direction of chapter 15 of the

Resolves of 1919, was presented on Jan. 10, 1920, and is published as House Document No. 1246 of that year.

The flow of streams in 1919 was somewhat in excess of the normal, and was the greatest that has occurred since 1903. The rainfall of 1919 was the first since 1903 that had been in excess of the normal, the chief excess occurring between May and November, the period when the flow of streams is usually most deficient. In consequence of this high rainfall and unusual flow of streams the effect of the pollution has been generally less noticeable than usual.

The results of chemical examinations of the more important rivers in recent years are presented in the following tables:—

Blackstone River.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Blackstone River, below Cherry Valley.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1909, . . .	.35	13.93	3.34	.0681	.0470	.0334	.0136	3.70	.0125	.0003	.80	—
1910, . . .	.32	16.42	3.92	.0633	.0489	.0387	.0102	4.02	.0146	.0002	.85	—
1911, . . .	—	21.02	4.40	.1277	.0726	.0559	.0167	5.70	.0080	.0005	1.15	—
1912, ¹ . . .	—	44.10	11.04	.2514	.2884	.1023	.1861	10.70	.0002	.0004	3.08	—
1913, . . .	—	32.32	6.52	.2591	.1628	.1122	.0506	8.18	.0015	.0004	2.06	—
1914, . . .	—	44.73	7.27	.3430	.1857	.1379	.0478	12.83	.0000	.0001	2.12	—
1915, . . .	—	19.23	5.15	.0985	.1142	.0785	.0357	3.08	—	—	1.89	—
1916, . . .	—	14.18	5.27	.0209	.0809	.0544	.0265	1.25	—	—	1.50	—
1917, . . .	—	20.67	7.48	.0406	.1279	.0762	.0517	2.36	—	—	2.20	—
1918, . . .	—	18.43	4.95	.1209	.1125	.0666	.0459	2.10	—	—	1.48	—
1919, . . .	—	16.24	4.90	.0894	.1221	.0625	.0596	4.04	—	—	1.65	—

¹ August omitted.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. —
Continued.

*Blackstone River, between Mill Brook Channel and the Sewage Precipitation Works
of the City of Worcester.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
				ALBUMINOID.					Nitrates.	Nitrites.	
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.				
1909.	-	52.97	18.55	.1865	.0381	.0239	.0142	4.80	.0033	.0010	-
1910.	.15	50.92	18.97	.1933	.0545	.0309	.0236	4.07	.0023	.0009	-
1911.	.11	44.64	15.70	.1920	.0449	.0212	.0237	4.03	.0170	.0009	-
1912.	.10	40.05	10.91	.2047	.0352	.0225	.0127	3.58	.0027	.0011	-
1913.	.10	35.17	10.34	.2767	.0491	.0285	.0206	3.18	.0003	.0008	-
1914.	.14	35.03	8.23	.2993	.0771	.0510	.0261	3.85	.0012	.0018	-
1915.	.13	39.00	11.68	.2383	.0650	.0392	.0258	2.96	-	-	-
1916. ¹	-	29.10	8.20	.2483	.0549	.0354	.0195	2.08	-	-	-
1917. ²	.23	42.38	11.04	.4864	.0612	.0379	.0233	2.19	-	-	-
1918.	.20	37.36	10.23	.2917	.0728	.0322	.0406	2.23	-	-	-
1919.	.37	28.06	7.08	.3168	.0808	.0361	.0447	1.63	-	-	-

¹ September omitted.

² November omitted.

Blackstone River, below Sewage Precipitation Works.

1909, ...	—	53.79	12.12	1.0567	.1282	.0792	.0490	6.92	.0067	.0075	—
1910, ...	—	52.15	12.52	1.0090	.1654	.0817	.0837	5.68	.0015	.0034	—
1911, ...	.21	53.25	13.15	.9967	.1608	.0651	.0957	6.54	.0152	.0072	—
1912, ...	.23	48.90	10.08	1.1700	.1673	.0904	.0769	6.12	.0137	.0096	—
1913, ¹	.28	40.68	10.46	.9320	.1286	.0719	.0567	4.49	.0158	.0084	—
1914, ...	.25	43.46	9.08	.8577	.1114	.0770	.0344	4.87	.0038	.0091	—
1915, ...	.13	39.45	6.77	.6370	.1032	.0575	.0457	3.58	—	—	—
1916, ¹	—	49.21	9.00	.6684	.1031	.0607	.0424	3.69	—	—	—
1917, ²	—	50.37	12.46	.9350	.0926	.0610	.0316	4.25	—	—	—
1918, ...	.61	39.03	8.40	.8590	.1370	.0687	.0683	3.42	—	—	—
1919, ...	.21	32.30	6.50	.5940	.0891	.0511	.0380	2.78	—	—	—

¹ September omitted.

² July omitted.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. —
Concluded.

Blackstone River, at Uxbridge.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.	
					Total.	Dissolved.	Suspended.				
1909, ...	.22	18.31	4.35	.3473	.0273	.0216	.0057	3.64	.0325	.0066	-
1910, ...	.26	22.53	4.69	.4963	.0356	.0302	.0054	4.62	.0498	.0043	-
1911, ...	.26	23.10	3.85	.3717	.0293	.0225	.0068	4.15	.0558	.0173	-
1912, ...	.21	21.91	3.06	.4897	.0345	.0288	.0057	4.06	.0497	.0137	6.5
1913, ...	.29	19.48	3.70	.3880	.0355	.0281	.0074	3.34	.0382	.0107	5.5
1914, ...	.25	23.72	2.84	.5285	.0355	.0284	.0071	4.55	.0482	.0154	7.2
1915, ...	.30	19.63	2.75	.3068	.0381	.0302	.0079	3.10	-	-	6.3
1916, ¹	.32	20.42	4.72	.3766	.0376	.0293	.0083	2.74	-	-	6.3
1917, ...	.22	22.21	4.28	.3904	.0365	.0286	.0079	3.27	-	-	-
1918, ...	.36	19.23	4.12	.2555	.0354	.0280	.0074	3.26	-	-	-
1919, ...	.37	17.96	3.76	.2342	.0330	.0275	.0055	2.55	-	-	-

¹ August omitted.

Blackstone River, at Millville.

1909, ...	.24	11.87	3.17	.1595	.0267	.0220	.0047	2.27	.0225	.0019	-
1910, ...	.30	13.94	3.32	.2350	.0277	.0234	.0043	3.01	.0290	.0013	-
1911, ...	.33	14.35	2.79	.1787	.0268	.0222	.0046	2.94	.0355	.0051	-
1912, ...	.29	15.20	2.18	.2433	.0283	.0249	.0034	2.91	.0421	.0064	-
1913, ...	.37	12.92	2.38	.1631	.0281	.0237	.0044	2.44	.0345	.0063	-
1914, ...	.28	14.33	2.78	.2245	.0304	.0243	.0061	2.78	.0233	.0065	-
1915, ...	.42	13.55	2.02	.1379	.0361	.0267	.0094	2.12	-	-	-
1916, ...	.38	13.31	2.78	.2284	.0266	.0199	.0067	1.86	-	-	-
1917, ...	.33	14.19	3.96	.1572	.0286	.0222	.0064	2.12	-	-	-
1918, ...	.42	13.87	3.42	.1166	.0334	.0252	.0082	2.21	-	-	-
1919, ...	.37	13.92	4.18	.1193	.0313	.0262	.0051	1.81	-	-	-

Charles River.

CHEMICAL EXAMINATION OF WATER FROM CHARLES RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Charles River, above Milford.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914, ¹	.34	4.03	1.43	.0046	.0228	.0178	.0050	.41	.0000	.0000	.35	0.9
1915, ¹	.75	5.00	2.27	.0039	.0296	.0260	.0036	.41	-	-	.84	1.1
1916, ¹	.49	4.70	2.23	.0058	.0219	.0207	.0012	.37	-	-	.75	1.0
1917,	.43	4.96	1.58	.0062	.0197	.0157	.0040	.35	-	-	.53	1.3
1918, ²	.37	4.15	1.26	.0096	.0209	.0155	.0054	.38	-	-	.41	1.2
1919,	.35	4.94	1.77	.0037	.0194	.0171	.0023	.34	-	-	.54	1.3

¹ Three months.

² Four months.

Charles River, below Milford.

1914,	.48	12.47	2.87	.2817	.0470	.0368	.0102	1.74	.0298	.0085	.74	3.3
1915,	.72	12.00	3.58	.1327	.0587	.0344	.0243	1.61	-	-	1.04	3.1
1916, ¹	.41	12.26	4.96	.1258	.0251	.0220	.0031	1.93	-	-	.81	2.9
1917,	.32	17.93	5.77	.4138	.0413	.0321	.0092	3.24	-	-	.49	3.7
1918, ²	.62	10.33	3.10	.0519	.0531	.0366	.0165	1.71	-	-	.95	-
1919,	.50	13.36	5.16	.2005	.0418	.0341	.0077	2.16	-	-	.74	-

¹ October omitted.

² Four months.

Charles River, opposite Pumping Station of Brookline Water Works.

1914,	.55	7.10	1.87	.0055	.0314	.0265	.0049	.92	.0032	.0001	.66	2.1
1916, ¹	.45	8.10	2.60	.0087	.0245	.0211	.0034	.96	-	-	.65	2.0
1917,	.70	7.93	2.72	.0053	.0394	.0270	.0124	.73	-	-	1.02	2.1
1918, ²	.66	7.25	2.50	.0084	.0401	.0323	.0078	.86	-	-	.80	1.9
1919,	.81	6.98	2.44	.0087	.0332	.0277	.0055	.78	-	-	.93	2.1

¹ Two months.

² Three months.

CHEMICAL EXAMINATION OF WATER FROM CHARLES RIVER, ETC. — *Concluded.**Charles River, opposite Pumping Station of Waltham Water Works.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1914, . . .	.52	7.45	1.98	.0117	.0353	.0297	.0056	.92	.0030	.0002	.57	2.6
1915, . . .	.93	8.30	2.97	.0131	.0475	.0407	.0068	.91	-	-	1.11	2.3
1916, . . .	.69	8.68	3.38	.0163	.0328	.0246	.0082	.89	-	-	.91	2.2
1917, . . .	.67	7.68	2.75	.0109	.0310	.0282	.0028	.80	-	-	.71	2.3
1918, ¹ . . .	.49	6.60	2.27	.0101	.0384	.0272	.0112	.96	-	-	.61	2.2
1919, . . .	.80	7.38	2.02	.0151	.0371	.0323	.0048	.76	-	-	.81	-

¹ Three months.*Chicopee River.*

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ware River, below Ware.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914, . . .	.60	10.47	3.15	.0501	.0704	.0488	.0216	.53	.0012	.0006	.82	-
1915, . . .	.76	9.43	3.41	.0317	.0746	.0427	.0319	.42	-	-	1.16	-
1916, . . .	.79	7.37	2.82	.0148	.0451	.0334	.0117	.36	-	-	1.04	-
1917, ¹ . . .	.53	8.38	2.68	.0529	.0630	.0376	.0254	.44	-	-	.74	-
1918, . . .	.66	8.08	3.26	.0319	.0647	.0414	.0233	.39	-	-	1.14	-
1919, . . .	.75	7.83	2.62	.0227	.0457	.0373	.0084	.31	-	-	1.14	-

¹ July omitted.

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES, ETC. — *Concluded.**Quaboag River, below Palmer.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1914, . . .	.49	6.62	1.62	.0144	.0243	.0176	.0067	.49	.0045	.0004	.35	-
1915, . . .	.56	6.00	2.12	.0128	.0336	.0236	.0100	.40	-	-	.62	-
1916, . . .	.64	6.02	2.54	.0134	.0278	.0209	.0069	.31	-	-	.70	-
1918, ¹ . . .	.26	5.70	1.88	.0149	.0220	.0156	.0064	.45	-	-	.41	-
1919, ² . . .	.49	5.20	1.85	.0100	.0207	.0160	.0047	.32	-	-	.56	-

¹ Four months.² June omitted.*Swift River, below Bondsville.*

1914, . . .	.35	4.97	1.67	.0037	.0304	.0219	.0085	.20	.0025	.0002	.55	-
1915, . . .	.46	4.95	1.83	.0052	.0269	.0202	.0067	.24	-	-	.64	-
1916, . . .	.49	4.22	1.67	.0026	.0193	.0160	.0033	.18	-	-	.69	-
1917, . . .	.33	5.07	2.02	.0034	.0224	.0166	.0058	.19	-	-	.50	-
1918, . . .	.34	4.35	1.63	.0055	.0197	.0155	.0042	.21	-	-	.49	-
1919, . . .	.43	4.80	2.06	.0046	.0203	.0177	.0026	.22	-	-	.59	-

Chicopee River, above Chicopee.

1914, . . .	.33	6.50	2.00	.0163	.0278	.0212	.0066	.51	.0095	.0008	.40	-
1915, . . .	.61	6.45	1.98	.0168	.0295	.0242	.0053	.39	-	-	.64	-
1916, ¹ . . .	.69	6.15	2.35	.0126	.0236	.0194	.0042	.32	-	-	.72	-
1917, ² . . .	.35	8.84	3.10	.0244	.0250	.0196	.0054	.36	-	-	.43	-
1918, ¹ . . .	.38	6.25	2.00	.0351	.0373	.0282	.0091	.46	-	-	.50	-
1919, ³ . . .	.50	6.23	2.80	.0232	.0261	.0213	.0048	.34	-	-	.60	-

¹ Four months.² June omitted.³ Three months.

Concord River.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Sudbury River, below Saxonville.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914.	.51	9.62	3.03	.0292	.0439	.0276	.0163	1.13	.0220	.0042	.61	—
1915.	.97	6.67	2.75	.0129	.0408	.0319	.0089	.73	—	—	1.04	—
1916. ¹	.62	7.20	2.10	.0315	.0311	.0264	.0047	.93	—	—	.74	—
1917.	.52	7.30	2.70	.0185	.0481	.0306	.0175	.63	—	—	.73	—
1918.	.52	6.68	2.52	.0158	.0340	.0242	.0098	.71	—	—	.59	—
1919.	.65	8.12	3.47	.0138	.0326	.0263	.0063	.77	—	—	.91	—

¹ June omitted.*Assabet River, above Westborough.*

1914.	.92	7.37	2.78	.0088	.0356	.0304	.0052	.41	.0034	.0001	.98	—
1915.	1.56	8.08	4.02	.0046	.0453	.0406	.0047	.46	—	—	1.74	—
1916.	1.01	7.52	3.20	.0033	.0298	.0260	.0038	.47	—	—	1.24	—
1917.	.82	8.11	3.43	.0088	.0325	.0281	.0044	.57	—	—	1.11	—
1918. ¹	1.20	7.46	3.42	.0286	.0400	.0315	.0085	.56	—	—	1.31	—
1919.	.86	7.25	3.07	.0068	.0331	.0276	.0055	.48	—	—	1.13	—

¹ September omitted.*Assabet River, below Westborough.*

1909.	1.70	19.24	8.91	.4140	.2281	.1616	.0665	1.94	.0005	.0005	2.90	—
1910.	2.23	17.07	7.00	.2598	.1334	.1018	.0316	2.16	.0078	.0018	2.20	—
1911.	.83	12.09	4.01	.0556	.0460	.0373	.0087	1.87	.0967	.0121	1.24	—
1912.	.66	12.71	4.01	.0975	.0419	.0357	.0062	2.20	.1998	.0132	.95	—
1913.	1.15	9.67	4.21	.0152	.0448	.0401	.0047	1.08	.1078	.0016	1.37	—
1914.	.80	10.21	3.14	.0089	.0399	.0339	.0060	1.59	.0195	.0005	1.01	—
1915.	1.62	9.46	4.28	.0118	.0539	.0438	.0101	1.87	—	—	1.83	—
1916.	.88	11.30	4.38	.0807	.0360	.0319	.0041	1.87	—	—	1.12	—
1917.	.80	10.08	3.68	.0425	.0361	.0352	.0029	1.03	—	—	1.04	—
1918. ¹	.85	9.18	3.57	.0427	.0424	.0333	.0091	1.10	—	—	1.08	—
1919.	.93	7.55	3.02	.0070	.0364	.0322	.0042	.53	—	—	1.25	—

¹ September omitted.*Assabet River, above Hudson.*

1914.	.44	6.80	2.10	.0066	.0275	.0222	.0053	.65	.0060	.0001	.53	—
1915.	.82	6.48	2.63	.0064	.0325	.0305	.0020	.55	—	—	1.02	—
1916.	.54	6.68	2.73	.0053	.0236	.0208	.0028	.61	—	—	.62	—
1917.	.60	6.64	2.26	.0057	.0288	.0223	.0065	.55	—	—	.57	—
1918.	.46	5.68	2.01	.0049	.0263	.0233	.0030	.71	—	—	.53	—
1919.	.62	6.52	2.46	.0064	.0276	.0244	.0032	.50	—	—	.74	—

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Concluded.*

Assabet River, below Hudson.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1909.	.51	8.81	3.26	.0161	.0403	.0296	.0107	.98	.0022	.0002	.64	-
1910.	.69	13.83	3.83	.0413	.0428	.0337	.0091	1.27	.0048	.0002	1.24	-
1911.	.64	12.83	4.30	.0817	.0532	.0400	.0132	.90	.0043	.0003	1.06	-
1912.	.78	18.08	3.99	.0939	.0752	.0494	.0258	1.02	.0053	.0002	1.28	-
1913. ¹	.76	13.29	3.34	.0727	.0704	.0577	.0127	1.07	.0036	.0004	1.28	-
1914.	.57	11.88	3.10	.0720	.0601	.0436	.0165	.98	.0042	.0002	1.03	-
1915.	.90	8.25	3.17	.0144	.0466	.0356	.0110	.59	-	-	1.16	-
1916.	.64	11.03	3.95	.0398	.0509	.0377	.0132	.70	-	-	.89	-
1917.	.63	10.36	3.57	.0250	.0522	.0376	.0146	.65	-	-	.77	-
1918.	.52	11.08	2.86	.0284	.0486	.0345	.0141	.77	-	-	.73	-
1919.	.69	8.04	3.44	.0103	.0464	.0359	.0105	.53	-	-	.95	-

¹ November omitted.

Assabet River, above Maynard.

1914.	.46	7.02	2.39	.0069	.0373	.0308	.0065	.82	.0014	.0002	.53	-
1915.	.92	7.08	2.63	.0104	.0403	.0336	.0067	.63	-	-	1.03	-
1916.	.64	7.25	2.47	.0127	.0302	.0260	.0042	.67	-	-	.81	-
1917.	.57	7.95	2.57	.0204	.0361	.0276	.0085	.63	-	-	.68	-
1918.	.64	7.63	2.33	.0154	.0363	.0325	.0038	.82	-	-	.75	-
1919. ¹	.76	7.92	2.72	.0353	.0445	.0381	.0064	.63	-	-	1.02	-

¹ August omitted.

Assabet River, below Maynard.

1909.	-	13.97	4.21	.1208	.0991	.0529	.0462	1.22	.0007	.0006	1.34	-
1910.	.59	13.15	4.68	.0708	.0885	.0446	.0239	1.82	.0038	.0006	.85	-
1911.	.58	12.73	4.17	.0738	.0650	.0408	.0242	1.41	.0060	.0006	1.08	-
1912.	-	12.94	3.92	.1205	.0771	.0494	.0277	1.46	.0026	.0010	1.04	-
1913.	.60	10.60	3.01	.0746	.0597	.0394	.0203	1.34	.0311	.0007	.85	-
1914.	.33	11.58	2.87	.0705	.0595	.0378	.0217	1.32	.0056	.0012	.73	-
1915.	.69	10.78	3.25	.0509	.0610	.0353	.0257	1.27	-	-	.99	-
1916.	.83	11.27	3.98	.0191	.0576	.0364	.0212	1.13	-	-	1.32	-
1917.	.67	12.08	4.14	.0684	.0332	.0440	.0392	1.30	-	-	1.07	-
1918.	.57	10.27	3.42	.0233	.0559	.0369	.0190	1.13	-	-	.81	-
1919. ¹	.95	8.49	3.35	.0336	.0446	.0370	.0076	.80	-	-	1.06	-

¹ August omitted.

Concord River, at Billerica.

1914.	.41	8.78	2.20	.0096	.0335	.0284	.0051	1.10	.0072	.0005	.50	-
1915.	.88	7.92	2.93	.0157	.0411	.0375	.0036	.84	-	-	1.05	-
1916.	.62	8.60	2.87	.0130	.0292	.0256	.0036	.85	-	-	.78	-
1917.	.54	7.42	2.32	.0166	.0321	.0268	.0053	.94	-	-	.55	-
1918.	.51	7.83	2.46	.0134	.0365	.0303	.0062	.94	-	-	.66	-
1919.	.68	7.72	2.48	.0157	.0311	.0267	.0044	.77	-	-	.86	-

Connecticut River.

CHEMICAL EXAMINATION OF WATER FROM CONNECTICUT RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Connecticut River, at Northfield Farms.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914.	.29	8.03	2.73	.0056	.0182	.0137	.0045	.17	.0012	.0001	.70	—
1915.	.30	7.08	2.08	.0031	.0162	.0124	.0038	.17	—	—	.60	—
1916. ¹	.37	6.90	2.10	.0032	.0152	.0135	.0017	.14	—	—	.80	—
1917. ¹	.35	7.40	3.08	.0055	.0196	.0139	.0057	.13	—	—	.63	—
1918.	.33	6.93	2.20	.0041	.0186	.0142	.0044	.19	—	—	.80	—
1919.	.33	6.95	2.15	.0050	.0182	.0155	.0027	.16	—	—	.76	—

¹ August omitted.*Connecticut River, below Springfield.*

1914.	.29	7.92	2.50	.0185	.0243	.0178	.0065	.30	.0023	.0003	.82	—
1915.	.35	7.15	2.38	.0091	.0216	.0151	.0065	.24	—	—	.69	—
1916.	.37	7.82	3.09	.0067	.0173	.0143	.0030	.20	—	—	.77	—
1917.	.36	8.30	3.30	.0106	.0227	.0174	.0053	.22	—	—	.67	—
1918.	.33	7.48	2.60	.0168	.0236	.0149	.0087	.26	—	—	.77	—
1919. ¹	.34	7.82	2.07	.0124	.0213	.0159	.0054	.27	—	—	.86	—

¹ August omitted.*Deerfield River.*

CHEMICAL EXAMINATION OF WATER FROM DEERFIELD RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Deerfield River, at Shelburne Falls.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914.	.45	4.80	1.57	.0062	.0222	.0167	.0055	.17	.0022	.0003	.56	—
1915.	.27	4.58	1.44	.0042	.0149	.0121	.0028	.16	—	—	.39	—
1916. ¹	.34	4.50	2.23	.0033	.0129	.0117	.0012	.23	—	—	.55	—
1917. ²	.22	4.97	1.90	.0035	.0113	.0093	.0020	.12	—	—	.20	—
1918.	.39	5.13	1.47	.0085	.0232	.0182	.0050	.23	—	—	.52	—
1919. ³	.26	6.28	1.44	.0056	.0151	.0131	.0020	.14	—	—	.41	—

¹ Four months.² Three months.³ August omitted.

CHEMICAL EXAMINATION OF WATER FROM DEERFIELD RIVER, ETC. —
Concluded.

Deerfield River, below Green River.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1914, ...	.30	5.68	1.80	.0124	.0182	.0143	.0039	.19	.0020	.0001	.43	-
1915, ¹	.22	5.41	1.28	.0211	.0195	.0128	.0067	.20	-	-	.34	-
1916, ...	.29	5.60	1.47	.0226	.0160	.0127	.0033	.21	-	-	.43	-
1917, ²	.24	8.68	2.90	.0161	.0187	.0148	.0039	.20	-	-	.36	-
1918, ...	.29	6.38	2.23	.0141	.0198	.0136	.0062	.25	-	-	.47	-
1919, ²	.32	5.08	1.53	.0086	.0181	.0153	.0028	.18	-	-	.48	-

¹ Four months.

² August omitted.

French River.

CHEMICAL EXAMINATION OF WATER FROM FRENCH RIVER. — AVERAGES FOR
 SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

French River, below Webster.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.								
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1914, ...	.40	8.50	2.48	.0500	.0675	.0399	.0276	.72	.0018	.0027	.69	-
1915, ...	.53	8.38	3.02	.0472	.0778	.0448	.0330	.80	-	-	.88	-
1916, ...	.60	8.03	2.55	.0521	.0593	.0402	.0191	.84	-	-	.86	-
1917, ...	.48	7.85	3.08	.0428	.0645	.0367	.0278	.61	-	-	.72	-
1918, ¹	.50	9.00	3.75	.0162	.0779	.0416	.0363	.80	-	-	.96	-
1919, ...	.53	9.52	4.02	.0257	.0492	.0317	.0175	.55	-	-	1.13	-

¹ Four months.

Hoosick River.

CHEMICAL EXAMINATION OF WATER FROM HOOSICK RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Hoosick River, at Williamstown.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.					Nitrates.	Nitrites.		
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.					
1914, . . .	.39	18.62	4.02	.0670	.0584	.0381	.0203	.83	.0037	.0015	.63	9.5
1915, . . .	.21	12.65	2.60	.0351	.0316	.0202	.0114	.49	-	-	.32	6.9
1916, ¹ . . .	.29	12.93	4.10	.0422	.0294	.0195	.0099	.67	-	-	.40	7.2
1917, ¹ . . .	.22	14.54	4.96	.0585	.0328	.0197	.0131	.59	-	-	.35	-
1918, ² . . .	.39	18.10	4.17	.0685	.0628	.0360	.0268	1.07	-	-	.76	-
1919, . . .	.33	16.10	3.78	.0339	.0397	.0227	.0170	.60	-	-	.64	-

¹ August omitted.² Three months.*Housatonic River.*

CHEMICAL EXAMINATION OF WATER FROM HOUSATONIC RIVER AND ITS BRANCHES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

East Branch, below Pittsfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1914, ¹	.24	13.82	3.27	.0509	.0351	.0271	.0080	.47	.0087	.0015	.53	-
1915,	.37	11.98	3.23	.0527	.0304	.0236	.0068	.35	-	-	.60	-
1916,	.34	12.67	4.00	.0496	.0292	.0225	.0067	.40	-	-	.54	-
1917,	.07	11.41	3.38	.0228	.0247	.0159	.0088	.22	-	-	.31	-
1918, ²	.17	10.65	2.60	.0178	.0201	.0166	.0035	.34	-	-	.39	-
1919, ³	.31	12.75	3.65	.0372	.0298	.0211	.0087	.34	-	-	.48	-

¹ Four months.² Two months.³ Three months.

CHEMICAL EXAMINATION OF WATER FROM HOUSATONIC RIVER AND ITS BRANCHES, ETC. — *Concluded.*

West Branch, below Pittsfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914, ¹ . . .	.20	14.62	2.75	.0288	.0495	.0313	.0182	.45	.0017	.0011	.61	-
1915, ² . . .	.34	16.62	3.72	.0671	.0691	.0359	.0332	.65	-	-	.63	-
1916, . . .	.18	12.93	3.78	.0568	.0432	.0228	.0204	.46	-	-	.29	-
1917, . . .	.20	14.00	4.43	.0429	.0378	.0204	.0174	.38	-	-	.49	-
1918, ³ . . .	.23	15.43	3.40	.0463	.0594	.0285	.0309	.65	-	-	.43	-
1919, ³ . . .	.31	16.50	4.45	.0103	.0429	.0283	.0146	.35	-	-	.62	-

¹ Four months.

² September omitted.

³ Three months.

Southwest Branch, at Pittsfield.

1914, ¹	.16	15.05	2.30	.0098	.0259	.0166	.0093	.24	.0072	.0005	.37	-
1915,	.14	15.25	2.95	.0070	.0243	.0159	.0084	.26	-	-	.30	-
1916,	.15	14.97	4.69	.0038	.0197	.0122	.0075	.20	-	-	.30	-
1917,	.17	16.98	4.30	.0326	.0292	.0172	.0120	.36	-	-	.35	-
1918, ²	.14	15.76	3.87	.0188	.0201	.0155	.0046	.32	-	-	.22	-
1919, ²	.13	12.95	3.30	.0115	.0187	.0123	.0064	.21	-	-	.29	-

¹ Four months.

² Three months.

Housatonic River, below Great Barrington.

1914, ¹	.22	17.62	4.22	.0147	.0372	.0268	.0104	.69	.0112	.0023	.42	-
1915,	.23	15.83	3.60	.0142	.0296	.0183	.0113	.46	-	-	.47	-
1916, ²	.22	15.40	5.80	.0143	.0230	.0174	.0056	.49	-	-	.40	-
1917, ²	.19	15.76	4.30	.0130	.0295	.0196	.0099	.52	-	-	.43	-
1918,	.21	16.65	4.97	.0166	.0273	.0210	.0063	.61	-	-	.41	-
1919,	.21	15.02	3.67	.0098	.0230	.0190	.0040	.46	-	-	.43	-

¹ Four months.

² June omitted.

³ September omitted.

Merrimack River.

CHEMICAL EXAMINATION OF WATER FROM MERRIMACK RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Merrimack River, above Lowell.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed:	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914.	.30	5.32	1.74	.0170	.0255	.0181	.0074	.35	.0037	.0003	.61	1.6
1915.	.46	5.43	2.18	.0140	.0273	.0205	.0068	.32	—	—	.79	1.3
1916. ¹	.50	6.02	2.06	.0078	.0197	.0169	.0028	.25	—	—	.77	1.3
1917.	.34	6.58	2.12	.0117	.0222	.0166	.0056	.36	—	—	.54	1.4
1918.	.37	5.88	2.05	.0140	.0238	.0191	.0047	.42	—	—	.72	1.5
1919.	.36	5.45	1.91	.0165	.0232	.0178	.0054	.35	—	—	.72	1.7

¹ October omitted.*Merrimack River, above Lawrence.*

1914, ...	.23	6.85	2.62	.0280	.0246	.0201	.0045	.59	.0190	.0003	.59	1.7
1915, ...	.33	7.05	2.83	.0183	.0230	.0177	.0053	.47	.0139	.0002	.69	1.6
1916, ...	.47	6.89	2.77	.0143	.0211	.0146	.0065	.43	.0175	.0004	.55	1.4
1917, ...	.44	6.54	2.53	.0147	.0203	.0169	.0034	.50	.0147	.0007	.47	1.2
1918, ...	.45	7.10	2.88	.0176	.0233	.0174	.0059	.53	.0132	.0010	.66	1.2
1919, ...	.42	7.37	3.23	.0214	.0211	.0159	.0052	.52	.0185	.0013	.61	0.9

Miller's River.

CHEMICAL EXAMINATION OF WATER FROM MILLER'S RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Miller's River, below Miller's Falls.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1914.	.44	5.17	1.85	.0073	.0251	.0204	.0047	.36	.0068	.0003	.49	—
1915.	.88	5.77	2.75	.0092	.0311	.0256	.0055	.31	—	—	.93	—
1916.	.80	4.85	2.14	.0093	.0274	.0212	.0062	.31	—	—	.97	—
1917.	.75	5.90	2.75	.0058	.0281	.0224	.0057	.25	—	—	.78	—
1918.	.62	4.90	1.67	.0058	.0267	.0226	.0041	.32	—	—	.73	—
1919.	.64	5.10	1.92	.0095	.0301	.0245	.0056	.30	—	—	.95	—

Nashua River.

CHEMICAL EXAMINATION OF WATER FROM NASHUA RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

North Branch of Nashua River, below Fitchburg.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1909.	.52	15.85	3.42	.3220	.0958	.0563	.0395	1.87	.0027	.0014	1.02	-
1910.	.60	20.11	4.90	.4047	.1235	.0789	.0446	2.29	.0017	.0009	1.03	-
1911.	.51	19.38	5.57	.2848	.1035	.0566	.0469	2.37	.0027	.0015	1.15	-
1912.	.57	19.62	4.99	.2380	.1007	.0560	.0447	2.20	.0032	.0019	1.22	-
1913.	.40	23.45	4.97	.2770	.1064	.0561	.0503	2.02	.0028	.0013	1.42	5.0
1914.	.41	26.93	5.78	.3260	.1156	.0662	.0494	2.60	.0020	.0006	1.55	5.9
1915. ¹	.41	14.68	3.52	.0578	.0745	.0296	.0449	1.26	-	-	.94	3.1
1916. ²	.42	18.52	5.12	.1043	.0778	.0380	.0398	2.12	-	-	1.03	3.2
1917.	.42	15.66	4.00	.0433	.0702	.0394	.0308	1.68	-	-	.74	-
1918.	.49	19.87	6.02	.0602	.0800	.0431	.0389	2.12	-	-	1.04	-
1919.	.37	22.16	6.84	.0618	.0714	.0444	.0270	2.00	-	-	1.25	-

¹ October omitted.² August omitted.*North Branch of Nashua River, at Lancaster.*

1909, ...	.44	12.26	3.41	.1556	.0330	.0284	.0046	1.46	.0360	.0066	.60	—
1910, ...	.45	13.44	3.82	.1655	.0462	.0366	.0096	1.63	.0388	.0108	.70	—
1911, ...	.51	15.64	4.10	.3067	.0828	.0408	.0420	1.95	.0208	.0083	.92	—
1912, ...	.45	12.65	3.10	.1252	.0438	.0275	.0163	1.68	.0343	.0083	.72	—
1913, ...	.43	15.45	3.02	.2292	.0533	.0386	.0147	1.75	.0133	.0053	.80	4.2
1914, ...	.39	16.80	3.15	.2147	.0466	.0336	.0130	1.94	.0262	.0116	.67	4.1
1915, ...	.42	12.10	3.49	.0757	.0465	.0294	.0171	1.31	—	—	.69	2.4
1916, ¹	.41	12.34	3.92	.0539	.0336	.0257	.0079	1.28	—	—	.73	2.7
1917, ...	.32	14.28	2.82	.0542	.0343	.0240	.0103	1.52	—	—	.51	—
1918, ...	.31	13.83	3.22	.0755	.0392	.0291	.0101	1.98	—	—	.55	3.4
1919, ...	.33	14.22	3.30	.0663	.0315	.0254	.0061	1.52	—	—	.64	—

¹ October omitted.*Nashua River, at Pepperell.*

1914, ¹	.31	12.67	2.75	.0595	.0459	.0286	.0173	1.27	.0132	.0027	.59	—
1915, ...	.46	8.25	2.27	.0222	.0328	.0237	.0091	.85	—	—	.63	—
1916, ²	.43	8.57	2.33	.0191	.0248	.0197	.0051	.78	—	—	.57	—
1917, ...	.39	10.96	4.06	.0434	.0357	.0204	.0153	1.25	—	—	.64	—
1918, ...	.31	10.75	3.00	.0338	.0305	.0210	.0095	1.53	—	—	.51	—
1919, ...	.34	9.93	3.28	.0258	.0245	.0218	.0027	1.04	—	—	.69	—

¹ Two months.² Three months.

Neponset River.

CHEMICAL EXAMINATION OF WATER FROM NEPONSET RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Neponset River, at Hyde Park.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.								
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1909.	-	28.69	9.08	.1723	.1218	.0898	.0320	5.35	.0027	.0009	2.02	10.0
1910.	-	31.37	10.16	.1740	.1333	.1000	.0333	5.84	.0010	.0002	2.96	10.4
1911.	1.24	18.82	5.49	.0786	.0727	.0539	.0188	3.36	.0025	.0007	1.86	7.1
1912.	.82	26.02	6.45	.1241	.1020	.0707	.0313	4.18	.0017	.0012	2.31	9.2
1913.	1.02	26.13	6.22	.0533	.0757	.0494	.0263	3.93	.0020	.0007	2.29	7.9
1914.	.93	20.27	4.37	.0754	.0697	.0484	.0213	3.43	.0025	.0008	1.31	5.2
1915.	1.23	19.67	6.30	.0530	.1078	.0649	.0429	2.42	-	-	1.92	5.3
1916.	1.28	19.47	5.37	.0466	.0761	.0554	.0207	2.37	-	-	1.96	-
1917.	.93	15.55	6.40	.0474	.0599	.0394	.0205	1.88	-	-	1.09	-
1918.	.87	19.65	5.87	.0968	.0808	.0494	.0314	2.68	-	-	1.51	-
1919.	1.09	13.74	4.20	.0389	.0540	.0382	.0158	1.73	-	-	1.53	-

¹ Four months.

Quinebaug River.

CHEMICAL EXAMINATION OF WATER FROM QUINEBAUG RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Quinebaug River, below Southbridge.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.					Nitrates.	Nitrites.		
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.					
1914.	.52	11.93	2.36	.3033	.0514	.0323	.0191	2.41	.0078	.0052	.47	—
1915.	.68	7.56	2.49	.1499	.0457	.0327	.0130	.82	—	—	.91	—
1916.	.54	8.12	3.32	.0867	.0367	.0266	.0101	.52	—	—	.76	—
1917.	.42	5.32	1.65	.0380	.0397	.0201	.0096	.35	—	—	.47	—
1918.	.50	7.35	2.77	.0471	.0351	.0256	.0095	.53	—	—	.64	—
1919.	.49	5.90	2.10	.0315	.0278	.0217	.0061	.32	—	—	.63	—

Taunton River.

CHEMICAL EXAMINATION OF WATER FROM TAUNTON RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Taunton River, below Taunton.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1914, ...	.92	18.10	3.33	.0701	.0389	.0323	.0066	5.95	.0100	.0020	.88	-
1915, ...	1.35	9.38	3.38	.0469	.0465	.0374	.0091	1.24	-	-	1.34	-
1916, ...	1.70	9.58	3.72	.0323	.0424	.0341	.0083	1.20	-	-	1.74	-
1917, ...	1.36	9.05	3.98	.0345	.0423	.0336	.0087	1.31	-	-	1.30	-
1918, ...	1.25	9.43	3.73	.0578	.0514	.0382	.0132	1.23	-	-	1.40	-
1919, ...	1.76	9.25	3.80	.0260	.0404	.0341	.0063	.91	-	-	1.98	-

Ten Mile River.

CHEMICAL EXAMINATION OF WATER FROM TEN MILE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ten Mile River, below Attleboro.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.					Nitrates.	Nitrites.		
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.					
1914, ...	.51	15.32	3.09	.1909	.0673	.0401	.0272	1.73	.0300	.0087	.77	-
1915, ¹	.88	11.10	3.30	.0954	.0494	.0346	.0148	1.37	-	-	.98	3.2
1916, ...	-	13.23	3.42	.0912	.0510	.0340	.0170	1.66	-	-	.91	3.0
1917, ²	.72	10.62	3.72	.0613	.0349	.0250	.0099	1.08	-	-	.66	-
1918, ²	.56	10.46	3.73	.0221	.0584	.0317	.0267	1.14	-	-	.80	-
1919, ...	.84	10.56	3.96	.0243	.0532	.0308	.0224	.99	-	-	.91	-

¹ June omitted.² November omitted.³ Three months.

Westfield River.

CHEMICAL EXAMINATION OF WATER FROM WESTFIELD RIVER. — AVERAGES
FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Westfield River, below Westfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrate.	Nitrite.		
					Total.	Dissolved.	Suspended.					
1914, . . .	.15	6.50	1.72	.0255	.0255	.0161	.0094	.33	.0101	.0013	.26	-
1915, . . .	.23	5.70	1.78	.0191	.0224	.0159	.0065	.27	-	-	.38	-
1916, . . .	.25	6.58	2.62	.0258	.0183	.0139	.0044	.26	-	-	.39	-
1917, . . .	.15	6.04	2.20	.0379	.0193	.0154	.0039	.31	-	-	.28	-
1918, . . .	.19	6.90	2.43	.0230	.0186	.0133	.0053	.32	-	-	.22	-
1919, . . .	.26	5.40	2.10	.0135	.0175	.0153	.0022	.23	-	-	.42	-

EXAMINATION OF SEWAGE DISPOSAL WORKS.

The average results of analyses of samples of sewage and effluent and statistics concerning the more important sewage disposal works in the State are presented in the following tables.

In general, the sewage delivered at most of the disposal works in the State has been greater in quantity and considerably more dilute than has been the case in previous years, a condition due to the unusual rainfall.

At Clinton and Natick, in particular, the disposal works have been overloaded during most of the year, while at Spencer a very large quantity of sewage overflows into the river because of an inadequate pipe line leading from the town to the filter beds, though the latter works are probably of adequate capacity for the disposal of all of the sewage of the town. A similar case at Milford has been corrected during the year by the construction of a new inverted siphon. At Pittsfield large quantities of sewage overflow into the river at times, and, according to the records, no sewage at all is pumped to the disposal works on holidays, the entire flow from the city on such days apparently being discharged directly into the Housatonic River. At Southbridge large quantities of sewage have overflowed into the river during the past year.

The sewage disposal works at Northbridge have been enlarged during the year, and the condition of the effluent discharged into the river from these works has been materially improved as compared with previous years. Additional disposal works are under construction at Brockton, with a view to relieving the surcharging of the filter beds, which are inadequate for the quantity of sewage now discharged from the city. It has been difficult, owing to the high cost of labor, to maintain municipal works in satisfactory condition in a number of places; nevertheless, the sewage disposal works, as a rule, have given satisfactory results.

TABLE No. 1. — Average Results of the Analyses of Monthly Samples of Sewage as received at the Disposal Works (Fats determined in about 70 Per Cent of the Samples).

[Parts in 100,000.]

City or Town.	RESIDUE ON EVAPORATION.				AMMONIA.				OXYGEN CONSUMED.		IRON.		Kjeldahl Nitrogen.	Fats.
	TOTAL RESIDUE.		LOSS ON IGNITION.		ALBUMINOID.		Chlorine.	Unfiltered.	Filtered.	Unfiltered.	Filtered.			
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.								
Andover.	45.50	32.42	13.38	23.31	12.89	10.42	3.71	77	35	.42	6.89	1.55	1.16	6.35
Arsoboro, ¹	27.70	23.20	5.50	10.80	6.45	4.35	2.81	.38	.20	.18	6.15	.155	1.05	5.24
Brockton, ²	60.04	43.90	17.04	30.08	18.88	12.20	7.64	1.07	.54	.53	9.65	.295	1.55	29.06
Clinton, ³	96.11	55.49	40.62	55.96	25.31	30.65	4.69	1.19	.57	.62	7.18	1.278	2.06	
Concord, ³	32.07	25.20	6.87	14.30	8.83	5.47	2.21	.41	.18	.23	5.45		.81	
Easthampton, ³	50.84	37.16	13.68	26.72	16.92	9.80	4.35	84	.48	.36	6.10		1.32	5.96
Framingham, ³	58.29	31.27	27.02	27.85	13.07	14.78	2.37	.82	.43	.39	6.71	1.433	1.72	5.96
Franklin, ³	91.11	49.89	41.22	56.49	22.98	33.51	4.34	1.34	.71	.63	8.61	.127	2.19	15.33
Franklin, ³	28.60	19.83	8.77	12.73	8.16	4.57	2.15	.38	.17	.21	3.10	.595	.58	
Gardner (Gardner area), ⁴	105.10	43.20	61.90	68.00	17.90	50.10	10.05	2.12	1.12	1.00	7.10	.467	4.02	20.00
Gardner (Templeton area), ⁴	53.76	36.44	17.32	28.07	14.75	13.32	6.43	1.16	.64	.52	7.35		2.05	5.11
Hopedale, ³	53.63	38.73	14.80	28.23	15.70	12.53	7.43	.96	.55	.41	9.39		1.84	
Hudson, ¹	129.38	97.65	31.73	45.49	24.74	20.75	6.70	1.67	.87	.80	33.07	.063	2.86	6.10
Leicester, ¹	32.86	22.93	9.93	17.53	10.00	7.53	2.69	.61	.32	.29	3.85	.155	.97	
Marion, ¹	23.50	18.36	5.14	10.42	7.58	2.84	1.45	.30	.17	.13	4.53	.393	.57	
Maldenborough,	55.00	36.78	18.22	28.33	14.60	13.73	4.13	.88	.44	.44	8.44		1.54	6.62
Milford,	58.97	46.20	12.77	27.23	17.42	9.81	3.49	.89	.51	.38	8.46		1.53	
Natick, ¹	39.84	32.82	7.02	15.73	10.49	5.24	2.78	.42	.23	.19	7.18	.248	.075	2.18
North Attleborough, ²	27.47	18.33	9.14	14.17	7.13	7.04	1.08	.32	.19	.13	3.37	.116	.63	
Northbridge, ³	34.80	26.20	8.60	20.00	12.83	7.17	3.63	.70	.42	.28	3.67		1.27	
Norwood,	64.82	53.16	11.66	24.10	15.46	8.64	3.42	.71	.40	.31	15.88	.068	1.09	3.92
Princeton, ¹	40.02	33.53	6.49	16.95	13.44	2.51	2.64	.45	.28	.17	4.42	.138	.92	2.23
Southbridge, ¹	45.40	34.70	10.70	25.10	16.50	8.60	3.92	.78	.47	.31	5.20	.260	1.54	
Spencer, ¹	29.60	21.90	7.70	15.34	8.40	6.94	3.34	.60	.31	.20	3.85	.075	0.93	2.51
Stockbridge, ⁴	32.27	26.73	5.54	13.33	8.73	4.60	1.81	.29	.17	.12	3.10		.51	
Westborough,	50.00	37.00	13.00	25.71	15.96	9.75	2.54	.70	.40	.30	6.85	.233	1.21	6.22
Worcester (day), ⁵	108.63	67.27	41.36	47.00	18.60	28.40	3.31	1.15	.43	.72	13.51	1.253	2.43	
Worcester (night),	88.92	57.05	31.87	40.02	16.32	23.70	1.97	.25	.50	.50	9.54	3.248	1.71	

1 Four samples. 2 At pumping station. 3 Every other month. 4 Three samples. 5 Seven samples.

TABLE No. 2. — Average Results of the Analyses of Monthly Samples of Sewage as applied to Filter Beds after Preliminary Treatment as indicated (Fals determined in about 70 Per Cent of the Samples).

[Parts in 100,000.]

CITY OR TOWN.	Form of Preliminary Treatment.	RESIDUE ON EVAPORATION.				AMMONIA.			Chlorine.	OXYGEN CONSUMED.		IRON.		Kjeldahl Nitrogen.	Fats.
		TOTAL RESIDUE.		LOSS ON IGNITION.		Free.	ALBUMINOID.			Unfiltered.	Filtered.	Unfiltered.	Filtered.		
		Total.	Suspended.	Total.	Dissolved.		Suspended.								
Andover	Tank.	36.64	31.24	5.40	15.89	12.15	3.74	63	7.68	3.34	1.99	108	.043	.79	3.48
ATTLEBORO, ¹	None.	27.70	22.20	5.50	10.80	6.45	4.35	38	6.15	2.81	1.30	135	.075	1.05	1.05
BROCKTON, ²	None.	60.94	43.90	17.04	31.08	18.88	12.20	54	9.65	7.64	5.25	295	.109	1.55	5.24
Clinton, ³	Basins.	49.83	39.78	10.15	23.40	15.51	7.80	64	9.12	3.05	8.15	1,130	.448	1.00	7.17
Concord, ⁴	None.	32.07	25.20	6.87	14.30	8.83	5.47	41	5.45	2.21	2.68	—	—	.81	—
Easthampton, ³	Tanks	49.04	34.72	14.32	24.88	14.08	10.80	72	5.78	5.23	2.62	—	—	1.20	—
FITCHBURG,	Inhoff tanks,	35.11	27.78	7.33	14.58	11.31	3.27	43	5.88	2.18	4.68	418	.186	1.80	2.70
Frammingham, ³	None.	91.11	49.59	41.22	56.49	22.98	33.51	34	9.61	2.94	3.16	595	.127	2.19	15.33
Franklin,	Tanks.	13.43	13.83	1.60	6.73	5.80	.93	11	8.73	1.02	1.07	1,130	.448	.23	—
Gardner (Gardner area), ⁴	None.	109.10	43.20	61.90	68.00	17.90	50.10	112	7.10	10.06	5.40	487	.087	4.02	20.00
Gardner (Templeton area),	Tanks,	32.73	26.46	6.27	12.70	10.14	2.65	36	5.26	3.12	2.19	158	.144	.076	.87
Hopedale, ¹	Tanks,	37.93	31.00	6.93	19.30	14.90	4.40	32	5.53	4.99	4.25	230	—	1.00	3.08
Hudson,	Tanks,	42.29	35.69	6.60	20.65	15.93	4.72	37	19.02	4.20	3.26	160	.070	1.01	—
Leicester, ¹	Tanks,	43.20	34.60	10.60	28.00	22.40	5.60	10	4.90	4.10	4.40	320	.060	1.45	6.86
Marion,	None.	23.50	18.36	5.14	10.42	7.58	2.84	30	4.53	1.45	2.88	393	.086	.57	—
MALDENBOROUGH,	Tanks,	51.78	40.36	11.42	23.42	15.55	7.87	68	8.62	4.14	5.15	302	.278	1.16	3.28
Milford,	Tanks,	44.87	38.63	6.24	18.05	14.07	3.98	54	6.85	3.34	3.32	167	.088	.91	—
Natick,	None.	39.84	32.82	7.02	16.75	10.49	5.24	23	7.18	2.78	1.73	248	.075	.72	2.18
North Attleborough, ³	Tanks,	29.00	19.97	2.03	6.40	5.50	.90	10	3.78	.88	1.32	.66	.077	.28	—
Northbridge, ³	Tanks,	16.03	14.16	1.87	6.63	5.78	.86	21	2.50	1.37	1.14	—	—	.93	—
Norwood,	Tank,	65.36	54.64	10.72	23.32	17.02	6.30	31	16.63	2.46	5.98	377	.338	1.24	4.82
Pittsfield, ³	None.	40.02	33.53	6.49	16.95	13.44	3.51	28	4.42	2.64	4.78	244	.138	.94	2.23
Southbridge, ¹	Tanks,	45.30	33.85	11.45	22.20	14.75	7.45	33	5.93	3.02	3.76	304	.215	.085	—
Spencer, ¹	None.	29.80	21.90	7.70	15.34	8.40	6.84	60	3.85	3.44	2.11	190	.081	.93	2.51
Stoughton, ¹	None.	32.27	26.73	5.54	13.33	8.73	4.60	29	3.10	1.81	2.43	—	—	.51	—
Stoughton, ¹	None.	50.00	37.00	13.00	25.71	15.96	9.75	40	6.85	2.54	6.27	363	.233	1.04	6.22
Worcester (day), ⁵	Tanks,	108.63	67.27	41.36	47.00	18.60	28.40	43	13.51	3.31	13.97	7,686	1.253	2.43	—

¹ Four samples.

² At pumping station.

³ Every other month.

⁴ Three samples.

⁵ Seven samples.

TABLE No. 3. — *Efficiency of Settling Tanks and Other Forms of Preliminary Treatment as indicated by the Foregoing Tables.*

[Parts in 100,000.]

CITY OR TOWN.	Form of Preliminary Treatment.	SUSPENDED SOLIDS.			TOTAL ALKALIMINOID AMMONIA.			OXYGEN CONSUMED.			FATS. ¹			CHLORINE.		Approximate Period of Sedimentation, assuming no Deposits (Hours).	Frequency of Cleaning Tanks during Year.
		Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent removed.	Raw Sewage.	Settled or Treated Sewage.		
Andover, ...	Tank.	13.38	5.40	60	.77	.63	18	4.80	3.34	30	6.35	3.48	45	6.80	7.68	1/2-2 1/4	Ten days to two weeks.
Clinton, ...	Basins.	40.62	10.15	75	1.19	.66	45	10.83	4.93	54	29.06	7.17	75	7.18	6.12	4-6	About once per month.
Easthampton, ...	Tanks.	13.68	14.32	75	.84	.72	14	6.08	5.43	31	—	—	—	6.10	5.78	—	—
Fitchburg, ...	Imhoff tanks, ²	27.02	7.33	73	.82	.43	48	7.32	4.68	36	5.96	2.70	55	6.71	5.88	—	As often as sludge beds would allow.
Franklin, ...	Tanks.	8.77	1.60	82	.38	.13	66	2.78	1.07	62	—	—	—	3.10	2.73	3 1/2-7 1/4	Ten times.
Gardner (Templeton area), ...	Tanks.	17.32	6.27	64	1.16	.36	70	6.66	2.19	67	5.11	1.86	64	7.35	5.26	5-8 1/4	First tank each month, others two to six months.
Hopedale, ...	Tanks.	14.80	6.93	53	.96	.54	43	7.52	4.25	44	—	—	—	9.39	5.53	20-30	Ones.
Hudson, ...	Tanks.	31.73	6.60	79	1.67	.67	60	10.02	4.32	57	6.10	3.08	50	33.07	19.02	12-20	Ones.
Malden, ...	Tanks.	18.22	11.42	37	.88	.68	23	7.12	5.15	28	6.62	3.28	50	8.44	8.62	—	Ten times.
Milford, ...	Tanks.	12.77	6.24	51	.89	.54	39	8.02	4.78	41	—	—	—	8.46	6.85	2-3 1/4	Three to four times.
North Attleborough, ...	Tanks.	9.14	2.03	78	.32	.14	56	2.48	1.32	47	—	—	—	3.37	3.78	2-6	Ones.
Northbridge, ...	Tanks.	8.60	1.87	78	.70	.21	70	4.85	1.14	77	—	—	—	3.67	2.50	3-5	Ones in two to four weeks.
Norwood, ...	Tank.	11.66	10.72	8	.71	.61	14	6.05	5.98	1	3.92	4.82	—	15.88	16.63	—	—
Southbridge, ...	Tanks.	10.70	11.45	—	.78	.53	32	5.60	4.78	15	—	—	—	6.20	5.80	—	—
Worcester, ...	Chemical Precipitation.	31.87	8.35	74	.75	.31	59	12.27	3.68	71	—	—	—	9.54	10.26	—	—

¹ Fats determined in about 70 per cent of the samples.² Five tanks; flow reversed eleven times.³ Several compartments; operated so as to get good sedimentation but not to produce a septic effluent.

TABLE NO. 4. — Average Results of the Analyses of Monthly Samples of Sewage applied to the Trickling Filters at Brockton and Fitchburg, and of their Effluents, etc. Per Cents removed, etc.

BROCKTON.

[Parts in 100,000.]

	RESIDUE ON EVAPORATION.						AMMONIA.				NITROGEN AS —		OXYGEN CONSUMED.		Kjeldahl Nitrogen.	Fats.	Remarks.
	TOTAL RESIDUE.			LOSS ON IGNITION.			Free.	ALBUMINOID.			Nitrates.	Nitrites.	Unfiltered.	Filtered.			
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.											
Sewage as applied to trickling filter.	60.94	43.90	17.04	31.08	18.88	12.20	7.64	1.07	.54	.53	8.15	5.25	1.55	5.24	The trickling filter has an area of .5 of an acre and a depth of 5.5 to 6.5 feet of crushed stone from 1.5 to 3 inches in size. The average rate of operation was about 1,153,000 gallons per acre per day.		
Effluent from trickling filter.	46.69	34.90	11.79	23.65	15.49	8.16	2.40	.61	.27	.34	5.19	2.01	.93	2.06			
Per cent removed, . .	23	-	31	24	-	33	69	43	-	36	36	62	40	61			
Settled effluent from trickling filter as discharged to Cowesett River.	40.32	34.85	5.47	17.51	14.15	3.36	2.66	.39	.21	.18	3.22	2.32	.56	1.62			
Per cent removed by tank, .	13	-	53	26	-	59	-	36	-	47	38	-	40	21	Period of sedimentation averaged about one and one-half hours. Tank cleaned once a week.		
Per cent removed by trickling filter and settling tank.	34	-	67	43	-	72	65	64	-	66	61	56	64	69			

FITCHBURG.

Inhoff tank effluent as applied to trickling filter.	35.11	27.78	7.33	14.53	11.31	3.27	2.18	.43	.29	.14	5.88	-	4.68	3.18	.84	2.70	The trickling filter has an area of 2.14 acres and a depth of 10 feet of stone from 1 to 3 inches in size.
Effluent from trickling filter.	32.82	28.76	4.06	13.44	10.66	2.78	.84	.25	.14	.11	5.83	1.0779	2.06	1.22	.47	1.80	The average rate of operation was about 1,565,000 gallons per acre per day.
Per cent removed, . . .	7	-	45	8	-	15	61	42	-	21	-	-	56	62	44	44	Period of sedimentation averaged about two and one-quarter hours. Tanks cleaned five times.
Settled effluent from trickling filter as discharged to Nashua River.	30.73	27.62	3.11	12.60	10.93	1.67	.86	.23	.15	.08	5.82	1.0510	1.77	1.30	-	1.08	
Per cent removed by tanks.	6	-	23	63	-	40	-	8	-	27	-	-	14	-	-	28	
Per cent removed by trickling filter and settling tanks.	12	-	58	14	-	49	61	47	-	43	-	-	62	59	-	60	

TABLE NO. 5. — *Average Results of the Analyses of Monthly Samples of Effluent from Sand Filters.*

[Parts in 100,000.]

CITY OR TOWN.	Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	NITROGEN AS —		Iron.
				Nitrates.	Nitrites.	
Andover, ¹	1.61	.1325	7.22	.4177	.0246	.474
Attleboro, ²	.57	.0460	4.46	.7950	.0208	.016
Brockton, ¹	3.44	.1333	8.77	.1381	.0040	1.751
Clinton, ¹	1.57	.0890	5.00	.1695	.0058	2.417
Concord, ³	.07	.0135	4.08	1.0610	.0077	.012
Easthampton, ³	.74	.0897	5.58	.9920	.0213	.373
Framingham, ¹	1.49	.1063	12.03	.8496	.0631	1.485
Franklin, ³	.51	.0382	2.86	.5050	.0075	.024
Gardner (Gardner area), ⁴	1.51	.1158	7.03	2.5700	.0202	.076
Gardner (Templeton area), ¹	1.52	.1490	7.00	1.7302	.0278	.062
Hopedale, ³	.81	.0676	4.94	3.2460	.0045	.054
Hudson,	.67	.0720	20.10	1.6447	.0452	.173
Leicester, ⁴	.72	.0867	3.10	.0870	.0008	.230
Marion,	.46	.0418	4.32	.3726	.0055	.172
Marlborough, ¹	.44	.0478	7.08	2.9082	.0061	.039
Milford,	1.13	.0816	5.91	.5266	.0093	.609
Natick,	1.75	.0904	6.94	.1482	.0038	.958
North Attleborough, ³	.03	.0114	3.00	.7193	.0013	.018
Northbridge, ³	.35	.0379	2.83	.7212	.0162	.276
Norwood,	.79	.0568	12.43	.4788	.0162	.394
Pittsfield, ¹	.90	.1114	4.28	.5305	.0118	.231
Southbridge, ¹	1.35	.0954	5.71	.8944	.0103	.817
Spencer, ³	.05	.0218	2.88	.7962	.0005	.022
Stockbridge, ⁵	.33	.0360	2.15	.4532	.0137	.101
Westborough, ¹	.40	.0636	4.31	.6177	.0268	.191
Worcester, ⁵	1.63	.0963	13.37	.8710	.0061	1.193

¹ Regular samples from two or more underdrains combined in one average.³ Every other month.⁴ Four samples.² Three samples.⁵ Seven samples.

TABLE No. 6.—*Efficiency of Sand Filters (Per Cent of Free and Albuminoid Ammonia removed).*

[Parts in 100,000.]

CITY OR TOWN.	FREE AMMONIA.			TOTAL ALBUMINOID AMMONIA.			CHLORINE.		Rate of Operation with Even Distribution (Gallons per Acre per Day). ¹
	Applied Sewage.	Effluent.	Per Cent removed.	Applied Sewage.	Effluent.	Per Cent removed.	Applied Sewage.	Effluent.	
Andover, ...	3.44	1.61	53	.63	.13	79	7.68	7.22	68,000
Attleboro, ...	2.81	0.57	80	.38	.05	87	6.15	4.46	40,000
Brockton, ...	7.64	3.44	55	1.07	.13	88	9.65	8.77	66,000
Clinton, ...	3.05	1.57	49	.66	.09	86	6.12	5.00	45,000
Concord, ...	2.21	.07	97	.41	.01	98	5.45	4.08	109,000
Easthampton, ...	5.23	.74	86	.72	.09	88	5.78	5.58	270,000
Framingham, ...	4.34	1.49	66	1.34	.11	92	8.61	12.03	50,000
Franklin, ...	1.02	.51	50	.13	.04	69	2.73	2.86	81,000
Gardner (Gardner area), ...	10.05	1.51	85	2.12	.12	94	7.10	7.03	82,000
Gardner (Templeton area), ...	3.12	1.52	51	.36	.15	58	5.26	7.00	
Hopedale, ...	4.99	.81	84	.54	.07	87	5.53	4.94	29,000
Hudson, ...	4.20	.67	84	.67	.07	90	19.02	20.10	45,000
Leicester, ...	4.10	.72	82	.77	.09	88	4.90	3.10	-
Marion, ...	1.45	.46	68	.30	.04	87	4.53	4.32	113,000
MARLBOROUGH, ...	4.14	.44	89	.68	.05	93	8.62	7.08	50,000
Milford, ...	3.34	1.13	66	.54	.08	85	6.85	5.91	93,000
Natick, ...	2.78	1.75	37	.42	.09	79	7.18	6.94	88,000
North Attleborough, ...	.88	.03	97	.14	.01	93	3.78	3.00	104,000
Northbridge, ...	1.37	.35	74	.21	.04	81	2.50	2.83	86,000
Norwood, ...	2.48	.79	68	.61	.06	90	16.63	12.43	104,000
PITTSFIELD, ...	2.64	.90	66	.45	.11	76	4.42	4.28	88,000
Southbridge, ...	3.02	1.35	55	.53	.10	81	5.80	5.71	118,000
Spencer, ...	3.34	.05	99	.60	.02	97	3.85	2.88	48,000
Stoughton, ...	1.81	.33	82	.29	.04	86	3.10	2.15	-
Westborough, ...	2.54	.40	84	.70	.06	91	6.85	4.31	83,000
WORCESTER, ...	3.31	1.63	51	1.15	.10	91	13.51	13.37	54,000

¹ See also Table No. 7.

TABLE No. 7. — *Extent of Sewerage Works, Rate of Flow and Rate of Operation of Sand Filters, etc.*

CITY OR TOWN.	Popu- lation, Census of 1915.	Approxi- mate Length of Sanitary Sewers (Miles).	Approxi- mate Number of House Con- nections.	ESTIMATED QUANTITY OF SEWAGE TREATED (GALLONS PER DAY).			Estimated Average Quantity of Sewage per Connection (Gallons per Day).	Net Area of Filter Beds (Acres).	Estimated Rate of Operation with Even Dis- tribution (Gallons per Acre per Day).
				Average for Year.	Average for Month of Maximum Flow.	Average for Month of Minimum Flow.			
Andover,	7,978	12.69	—	247,000	320,000	151,000	—	3.65 ¹	68,000
ATTLEBORO,	18,480	30.86	1,082	617,000	970,000	145,000	570	15.50	40,000
BROCKTON,	62,283	85.33	6,376	3,011,000 ²	—	—	472	37.00	66,000 ³
Clinton,	13,192	21.24	1,558	1,169,000 ²	1,673,000	884,000	750	26.23	45,000
Concord,	6,681	8.69	469	468,000 ²	598,000	314,000	—	4.28	109,000
Easthampton,	9,845	—	—	600,000 ²	—	—	—	2.20	270,000
FITCHBURG,	39,656	57.40	—	3,350,000	—	—	—	—	—
Frammingham,	15,860	28.01	2,296	1,047,000 ²	1,307,000	794,000	456	21.12	50,000
Franklin,	6,440	—	346	264,000	458,000	70,000	763	3.24	81,000
Gardner,	16,376	28.14	1,803	1,044,000 ²	1,110,000	479,000	579	12.50 ⁴	82,000
Hopedale,	2,663	—	—	110,000 ²	156,000	68,000	—	3.79	29,000
Hudson,	6,758	9.68	643	405,000 ²	424,000	369,000	630	9.00	45,000
Leicester,	3,322	—	156	85,000 ²	—	—	—	3.36	—
Marion,	1,487	3.92	156	—	—	—	545	75	113,000
MARLBOROUGH,	15,250	29.81	2,134	1,033,000	1,700,000	644,000	492	20.80	50,000
Milford,	13,684	17.96	1,295	865,000	998,000	577,000	668	9.30	93,000
Natick,	11,119	15.60	1,392	1,114,000 ²	1,646,000	616,000	800	12.40	88,000
North Attleborough,	9,398	16.60	592	725,000 ²	801,000	437,000	1,225	7.00	104,000
Northbridge,	9,254	—	—	513,000	565,000	463,000	—	6.00	86,000
Norwood,	10,977	17.81	1,091	1,100,000	—	—	1,008	10.54	104,000
Pittsfield,	39,607	61.17	4,761	3,612,000 ²	4,150,000	3,049,000	759	41.15	88,000
Southbridge,	14,217	16.33	1,114	1,000,000 ²	—	—	897	8.50	115,000
Spencer,	5,994	—	—	450,000 ²	—	—	—	9.30	48,000
Westborough,	5,925	—	—	483,000	668,000	309,000	—	5.80	83,000
WORCESTER,	162,697	183.97 ⁵	—	3,885,000 ²	—	—	—	72.60	54,000

¹ Additional area under construction.² From pumping records.³ Not all of sewage treated.⁴ Gardner area, 2.50 acres. Templeton area, 10 acres.⁵ Includes 69.81 miles of combined sewers.⁶ Amount treated by sand filters. Total flow 21,610,000 gallons per day.

TABLE No. 8. — *General Features.*

[For data concerning the trickling filters at Brockton and Fitchburg see Table No. 4.]

CITY OR TOWN.	Year of Construction of and Additions to Works.	Depth of Under-drains (Feet).	Distance of Apart of Under-drains (Feet).	Filtering Material.	Attention given to Disposal Works.
Andover, ...	1898	4	20	Fair sand, small quantity of gravel; practically all handled in construction.	One man all the time.
ATTLEBORO, ...	1912, 1913	4-7	35	Excellent sand and gravel; found in place, ...	One man all the time; others when necessary.
BROCKTON, ...	1893, 1905	5.5	30	Good sand and gravel; found in place, ...	Four men all the time; large force when necessary.
Clinton, ...	1908, 1912				
Concord, ...	1898, 1899	8	60-70	Good sand and gravel; found in place, ...	Two men all the time; others when necessary.
Easthampton, ...	1899	none	-	Good sand underlaid with gravel; found in place, . .	One man once a day.
Framingham, ...	1908	3.5	20-40	Good sand and gravel; largely found in place, . .	One man all the time; one other when necessary.
Franklin, ...	1890	4-4.5	30-40	Good sand and gravel, ...	Three or more men in summer; only one in winter.
	1915	4.5	26	Good sand and gravel, ...	One man every two or three days; others when necessary.
Gardner (Gardner area), ...	1891	5	20	Good sand; handled in construction, ...	One man all the time; others when necessary.
Gardner (Templeton area), ...	1901, 1909	3-4	20-30	Coarse sand; handled in construction, ...	One man all the time; more when necessary.
Hopedale, ...	1900	3	35-60	Some good sand and some rather fine sand, ...	One man all the time.
Hudson, ...	1904, 1910	5-6	50-100	Good sand and gravel; found in place, ...	One man all the time; others when necessary.
Leicester, ...	1894	4	8	Hard, compact sand; found in place, ...	Very little attention.
Marion, ...	1906	5	-	Mostly good sand; pockets of fine sand and some ledge; largely found in place, ...	One man every day in summer; every other day in winter.
MARLBOROUGH, ...	1891, 1908	4.5-6	30-50	Rather fine sand; found in place, ...	One man all the time; others when necessary.
	1909, 1910, 1911				
Milford, ...	1907	5	40	Rather fine sand; found in place, ...	One man every day; others when necessary.
Natick, ...	1896	6	36	Sand of good quality, but strata of very fine sand in places; found in place, ...	One man all the time; others when necessary.
North Attleborough, ...	1909, 1910	5-6.5	55	Coarse sand and gravel; largely found in place, . .	One man every day; others when necessary.
Northbridge, ...	1906, 1907	4	50-75	Coarse sand and gravel; mostly handled, ...	One man all the time; others when necessary.
Norwood, ...	1909	4-6	40	Good sand and gravel; found in place, ...	One man every day; others when necessary.
Pittsfield, ...	1901, 1915	4	35	Good sand; mostly found in place, ...	Two men all the time; others when necessary.
Southbridge, ...	1908	4	40	Fair sand and gravel; considerable quantity handled, some found in place, ...	One man once a day.
Spencer, ...	1897	-1	-	Good sand and gravel; largely found in place, . .	One man all the time; others when necessary.
Stockbridge, ...	1899	3-4.5	23	Sand filters, good quality sand, ...	One man all the time.
Westborough, ...	1892, 1911	3-4.5	30-40	Irrigation area, rather fine sand, ...	One man all the time.
WORCESTER, ...	1898:	4-6	35-50	Good sand and gravel; handled in construction, . .	Several men all the time; a large force when necessary.

1 Only 3 beds underdrained.

2 Year of first construction of sand filters. Many additions.



DIVISION OF WATER AND SEWAGE LABORATORIES

H. W. CLARK, *Director*



REPORT OF DIVISION OF WATER AND SEWAGE LABORATORIES.

This Division was engaged during the year in carrying on its usual analytical and research work, this work being done under the provisions of the act entitled "An Act to protect the purity of inland waters of the State," and also of many special acts concerning the public welfare and public health as relating to water supply, sewerage, sewage disposal, condition of rivers, etc. In carrying out the provisions of these acts, and to enable the Department to give such advice as was requested during 1919 on questions submitted in regard to water supply, sewage disposal, etc., 5,582 samples of water, sewage, etc., were analyzed in the State House laboratories of this Division, and 3,521 microscopical and special chemical examinations were made, divided approximately as follows: —

Samples from public water supplies: —

Surface waters, ...	1,904
Ground waters, ...	1,148
Samples from rivers, ...	1,014

Samples from sewage disposal works: —

Sewages, ...	437
Filter effluents, ...	657
Samples of wastes and effluents from factories, ...	168
Samples of sea water from various locations, ...	34
Miscellaneous samples (color, hardness, chlorine, etc.), ...	220

5,582

Special examinations of water for manganese, lead, etc., ...	277
Determinations of fats, alkalinity, etc., ...	440
Microscopical examinations, ...	1,856
Determinations of dissolved oxygen, carbonic acid, etc. (field work), ...	948

3,521

Many investigations were carried on during the year in regard to approved and new methods for the treatment and purification of water, sewage and trade wastes, and an extended investigation was

made concerning the bacterial quality of shellfish coming from different areas along our coast. A large part of the research work of the Division is carried out at the experiment station, although considerable is done in the State House laboratories. The station is also the laboratory where all the bacterial work of the Department is done in regard to water supplies, rivers, sewage disposal, purification of water, sewage, etc.

At the station laboratories 5,881 samples were examined during the year, divided as follows:—

Chemical examinations on account of investigations concerning the disposal of domestic sewage and factory wastes, ...	1,245
Chemical examinations on account of investigations in connection with filtration and other treatment of water supplies and swimming pools, .	632
Mechanical and chemical examinations of sand, ...	64
Bacterial examinations of water from public water supplies, rivers, sewage effluents, ice, etc., ...	1,334
Bacterial examinations in connection with methods of purification of sewage and water, ...	1,916
Bacterial examinations of shellfish, ...	690
	5,881

The following pages contain a very brief summary of some of the research work carried on during the year.

INVESTIGATIONS IN REGARD TO THE BACTERIAL QUALITY OF SHELLFISH.

During the past twenty years frequent examinations have been made by this Division of shellfish, including clams, quahaugs and oysters, collected along our coast. During recent years questions in regard to the bacterial pollution of soft clams have demanded the greatest amount of attention, and it has been necessary for the Department to define flats from which such shellfish could be safely taken, and areas from which their taking would be dangerous to health, and hence forbidden.

In order to gain further information along this line, a very complete investigation was made during the year in regard to the bacterial quality of clams taken from (1) what is known to be a badly polluted area; (2) from a slightly polluted area; and (3) from as unpolluted an area as probably can be found on the northeastern coast of the State, these three areas being the Joppa flats at Newburyport, flats on the Ipswich River some distance below the town of Ipswich, and flats at Treadwell Island Creek, so called, on the Ipswich shore.

In this investigation, besides determining the bacterial quality of the clams from these three sources, two other main points were investigated: (1) the seasonal variation of bacteria found in the clams, and (2) the value or availability of the scoring method, so called, as devised by a committee of the American Public Health Association to determine the condition of shellfish. By this method five samples of clams from each station on a flat are examined to determine whether coli are present in .01, .1, 1 and 10 cubic centimeters of the shellwater of each.

It is not necessary to summarize the details of this method here, but a table is given showing the B. coli score, so called, of the clams collected during nearly every month of the year from these areas. Over the Newburyport flats the sewage of the city flows mingled with the water of the Merrimack River and sea water; the flats on the Ipswich River below Ipswich receive some pollution, although the town of Ipswich is not sewered, while the Treadwell Island flats are, as stated, practically unpolluted. All the stations on the Newburyport flats as numbered on the table were from 3,000 to 6,000 feet below the sewer outlet, and stations Nos. 4 and 5 were the ones farthest from the sewer and in such a direction from it that the smallest volume of sewage undoubtedly reached them. The great difference in the B. coli score of the unpolluted Treadwell Island clams and the Newburyport clams is clearly indicated, and also the great seasonal variation occurring at the Joppa flats. This scoring method is undoubtedly the most satisfactory way of summarizing the bacterial results obtained from clams from different sources.

B. Coli Tests of Clams by the Scoring Method.

1919.	NEWBURYPORT.					IPSWICH.	
	Station No. 1.	Station No. 2.	Station No. 3.	Station No. 4.	Station No. 5.	Treadwell Island Creek.	Ipswich River, below Ipswich.
January 27, ...	-	-	-	-	-	5	-
February 6, ...	-	-	-	-	-	4	-
May 6, ...	-	-	-	-	-	5	23
May 20, ...	3,200	230	500	50	410	-	-
June 5, ...	5,000	4,100	1,400	410	500	1	-
June 19, ...	500	500	2,300	410	320	4	140
July 7, ...	320	32	50	23	23	4	-
July 21, ...	50	230	450	140	41	2	140
August 4, ...	500	500	4	4	3	1	32
August 18, ...	500	140	5	14	4	-	4
September 15, ...	230	33	410	140	50	32	500
October 14, ...	500	230	320	50	50	14	500
November 14, ...	1,400	-	410	410	140	14	500

*Average Bacterial Analyses.**Water from Ipswich River just below Town of Ipswich.*

Number # of Samples.	BACTERIA PER CUBIC CENTI- METER.			PER CENT OF SAMPLES CONTAINING B. COLI.				
	20° C.	37° C.		.001 c. c.	.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.
		Total.	Red.					
8	9,970	2,300	830	25	50	87	87	100

Water from Treadwell Island Creek.

4	1,170	47	10	0	0	0	25	75
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INVESTIGATIONS IN REGARD TO FACTORY WASTES.

During the year considerable work was done concerning the wastes from various industries in the State; for example, wastes from the Acushnet Process Company, New Bedford, engaged in reclaiming rubber; from the Essex Aniline Works, South Middleton, engaged in the manufacture of aniline dyes; from various tanneries and glue works in Peabody and Danvers; from gas works, these wastes entering Collins Cove, Salem; from the Springdale Finishing Company, Canton, and from the Merrimac Chemical Company, North Woburn. Reports in regard to all this work were made to the Department in order that advice could be given concerning the treatment of these various wastes.

EXPERIMENTS WITH SEWAGE SLUDGE. — DEWATERING WITH A CENTRIFUGAL MACHINE.

During the year experiments were made upon removing water from sludge by the Tolhurst centrifugal machine. This machine was of the 12-inch type, and provided with interchangeable sludge baskets. With the perforated basket it is necessary to use a lining of cloth or like material, and the action is one of filtration induced by the centrifugal action. In experiments with this basket two kinds of cloth and filter paper were tried, but with little success, these linings quickly becoming clogged. In all subsequent work a tight basket was used and the apparatus run at a speed of 1,980 revolutions a minute. This second basket has a lip about $1\frac{1}{2}$ inches wide extending from the

top towards the center, and the sludge is by centrifugal motion held against the side of the machine, and the liquid passes up over the lip and out of the basket. All the resulting sludge from centrifugal treatment was in a condition to be readily shoveled or otherwise handled, and had a specific gravity ranging from below 1.01 up to 1.04. The percentage of water in the sludges centrifuged varied from 92.28 per cent in sludge from an ordinary settling tank to 97.82 per cent in activated sludge, and the percentage in the resulting sludge varied from 61 to 81. Usually the machine retained at least 55 per cent of the solid matter of the sludge treated, but about 45 per cent escaped with the overflow. In all cases the overflow water could be termed a very strong sewage or weak sludge, and needed treatment in the machine to collect the remaining solids. It did not seem from our experiments that the machine was particularly satisfactory.

The following table gives the results of certain experiments, and shows the volume of sludge treated in each experiment, the per cent of contained water, the time of centrifuging, the per cent of water removed from the sludge and dry matter in the overflow:—

1919.	SLUDGE FROM —	Gallons of Sludge used.	Per Cent of Water in Sludge used.	Time — Minutes centri-fuging.	Pounds of Wet Sludge re-covered.	Per Cent of Water in Re-covered Sludge.	Per Cent Dry Matter in Over-flow.
June 30	Settling tank, . . .	7	92.28	60	10.50	61.1	3.74
July 8	Activated sludge Tank No. 485.	12	97.82	30	7.50	81.3	1.54
8	Effluent from previous run, .	11	98.46	105	7.00	90.2	.74
8	Effluent from previous run, .	10	99.26	60	4.50	90.6	.29
8	Effluent from previous run, .	9	99.71	60	1.00	90.8	.23
8	Alum precipitation, . . .	5	97.18	60	7.50	84.3	.57
8	Effluent from previous run, .	4	99.43	60	1.50	86.4	.26
10	Activated sludge Tank No. 485.	10	96.20	30	9.00	78.2	1.44
10	Effluent from previous run, .	9	98.56	40	7.00	86.5	.30
10	Effluent from previous run, .	8	99.70	40	1.25	88.8	.14
11	Settling tank, . . .	10	97.60	30	8.75	80.0	.45
11	Effluent from previous run, .	9	99.55	60 ¹	2.55	81.1	.13
29	Alum precipitation, . . .	10	96.25	30	10.00	80.2	1.34
29	Effluent from previous run, .	9	98.66	60 ¹	5.00	84.7	.58
Oct. 23	Settling tank, . . .	10	96.79	30	8.00	77.6	2.31
23	Effluent from previous run, .	9	97.69	30	6.00	85.0	1.25
Nov. 3	Digestion tank, . . .	10	95.40	30	8.50	68.0	2.05
3	Effluent from previous run, .	9	97.95	30	7.50	84.3	.36

¹ Run through the centrifuge twice in this time.

STABILIZING SEWAGE SLUDGE BY OXIDATION WITH NITRATES FROM
SEWAGE FILTER EFFLUENTS.

This investigation in regard to the treatment of sludge to destroy its offensive properties and render its disposal at certain municipal filtration areas free from all but slight odors was continued during the year. The work was carried on with Tank No. 483, which is made of Akron pipe set in concrete and divided into three compartments, connected in series, each 4 feet deep with a capacity of about 65 gallons. Sewage sludge was passed into these compartments in rotation, and a maximum storage of three months was given. The inlets and overflows of the tank are so arranged that the effluents applied passed through all three compartments, entering at the bottom and leaving about 6 inches below the surface of each.

The greater part of the effluent used came from trickling filters, although some contact filter effluent was applied. The volume applied daily averaged 2.29 volumes of effluent for each volume of sludge containing 5 per cent of solids in the three compartments; that is, each gallon of sludge was treated with over 200 gallons of effluent. Seventy-nine per cent of the samples of the applied effluents were stable, and the average suspended solids were 12.2 parts in 100,000; 38 per cent of the samples of overflow were stable and there were 7.9 parts in 100,000 solids in suspension. The sludge after four weeks' tank treatment was always inoffensive, and almost invariably remained so when removed from the tank. During this process the sludge lost nitrogen and organic matter, and the fats were oxidized as in the activated sludge process.

Average analyses of the applied filter effluent, of the overflow from the last compartment, and sludge analyses on a dry basis are shown in the following tables: —

Effluent applied to Tank No. 483.

[Parts in 100,000.]

AMMONIA.			Kjeldahl Nitrogen.	NITROGEN AS —		Oxygen consumed.
Free.	ALBUMINOID.			Nitrates.	Nitrites.	
	Total.	In Solution.				
2.87	.54	.28	1.00	1.36	.0841	2.94

Overflow from Tank No. 483.

2.92	.36	.24	0.68	0.31	.0603	2.23
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Sludge Analyses.

SLUDGE FROM —	PER CENT ON DRY BASIS OF —		
	Fats.	Nitrogen.	Loss on Ignition.
Settling tank applied to Tank No. 483, . . .	19.3	4.01	69.2
Tank No. 483: —			
After four weeks, ...	8.9	2.85	50.4
After eight weeks, ...	7.9	2.86	51.5
After twelve weeks, ...	7.1	3.10	56.4

PURIFICATION OF SEWAGE BY AERATION. — ACTIVATED SLUDGE.

The activated sludge process of sewage purification which had its inception at Lawrence in 1912 was investigated further during 1919. Tank No. 485, put into operation on April 10, 1917, was continued in operation throughout the year on the continuous flow plan. As stated in previous reports it consists of three compartments, each about 75 inches deep over conical bottoms and the overflow or effluent from it is passed to a settling tank 92 inches deep. It was so operated during the year that the time of passage of sewage through it was theoretically 5.75 hours, and the air applied equaled 2.6 cubic feet per gallon of sewage treated. The rate of operation followed, that is, the volume of sewage treated, was equal to the treatment of 5,900,000 gallons a day in a tank of equal depth and 1 acre in area.

During the first six months of the year air was applied through the perforated, hollow, circular brass discs described in the last report, and during the latter part of the year through alundum tubes. These tubes gave better air distribution than any form of distributor that so far has been tested, but have the disadvantage of being rather easily broken. The sludge collected in the settling tank is drawn at intervals of an hour or so into a 200-gallon iron sludge storage tank, where it is aerated with the same proportion of air per gallon of sludge as is used in the main activated tank, and pumped back into the first section of this main tank three times daily.

The effluent from the plant was stable throughout the year, and contained a small amount of nitrates; the organic matter, as shown by albuminoid ammonia determinations, was one-fourth that of the applied sewage, that is, there was a removal of organic matter of 75 per cent; and a slightly greater percentage of improvement was shown by the oxygen consumed results. The entering sewage contained 1,875 pounds of matters in suspension per million gallons, the

effluent from the tank 250 pounds, and 1,130 pounds per million gallons were recovered from the sludge tanks, showing a loss of 495 pounds, that is, the amount of organic matter apparently oxidized to carbon dioxide and free nitrogen. It was found that the best results were obtained when the sludge in the activated sludge tanks amounted to about 20 per cent of the total volume held by these tanks.

AGITATION OF ACTIVATED SLUDGE WITHOUT AIR.

The value of air in activated sludge work has been questioned by some students of sewage purification, and experiments have been made whereby sludge has been agitated in the sewage by mechanical means. In order to investigate this point an experiment was made at the station during the year by which sewage was treated in a revolving cylinder. In order to test out the value of agitation merely as compared with agitation of air, this cylinder was filled two-thirds full of sewage, the right proportion of activated sludge placed in it, this sludge being taken from a tank in good operation, and the cylinder so operated as to make 30 revolutions a minute. As a result of all this work, it was found that when the oxygen of the air became exhausted in the cylinder, not only was further purification prevented, but organic matter actually went into suspension or semi-solution from the activated sludge used, and the effluent was of poorer character than the sewage before treatment. It was only when air was allowed to enter the cylinder frequently that results approximating those obtained in a true activated sludge tank were obtained. The experiment was continued long enough to determine these points accurately.

SELF-PURIFICATION OF QUIESCENT SEWAGE.

It is well known that if sewage is allowed to stand long enough it will eventually become stable and nitrification take place, and experiments upon this point were made by this Division and published in the report of the Department for 1901.¹ To study this, two outdoor tanks, 17 feet 4 inches in diameter were used. One of them had a concrete roof excluding light and air currents, and the other was open. Two feet in depth of sewage were placed in the covered tank on July 29, and the same volume in the open tank on August 5. In three days a heavy green growth, consisting mostly of *Protococcus*, developed in the open tank, mosquito larvæ soon appeared in large numbers, and in a week the green growths had largely disappeared, probably being destroyed by these larvæ. A month after the experiment was started gasoline at the rate of 300 gallons per acre was applied to the tank,

¹ A Study of the Stability of the Effluent of Sewage Filters of Coarse Materials, pp. 371-393.

killing all the larvæ in three hours. Two days later the green growth reappeared; on September 12, seven days after the larvæ were killed, newly hatched larvæ appeared, but not in such numbers as during warmer weather, and they were not able to check the green growth which persisted until October 1, when the tanks were emptied. No algæ grew in the covered tank, but mosquito larvæ appeared in perhaps half the numbers that were in the open tank. There was an odor of sewage about the open tank for a day or two after filling, after which it was practically odorless. There was always a decidedly musty odor in the closed tank, but it was not the offensive odor of stale sewage.

Dissolved oxygen appeared in the sewage in the open tank in about two weeks, and fluctuated from a 2 per cent saturation to over 90 per cent. It was a week later in appearing in the covered tank, and fluctuated between 1 and 30 per cent of saturation. The temperature of the sewage in the tanks was taken twice daily, — in the morning and at noon. In the open tank the two averages were 64° F. and 67° F., respectively, with a minimum of 57° F. and a maximum of 73° F. for the whole period. In the covered tank both average temperatures were 64° F., with a minimum of 60° F. and a maximum of 72° F.

The sewage in the open tank became stable in about six weeks, although it would probably have been stable sooner except for the decaying green growths. The sewage in the covered tank took about a week longer to acquire stability, but became well clarified in a little over a week. There was no measurable evaporation in the covered tank. The rainfall during the course of the experiments was 7.70 inches. The increase in depth of sewage in the open tank was 2.25 inches, hence apparently 5.45 inches evaporated.

On October 6 the tanks were refilled with sewage. A heavy green growth appeared in a day or two in the open tank and persisted until November 12, when the tank was emptied. There were only a few mosquito larvæ, and these disappeared about November 1. Five days after filling, the dissolved oxygen was 35.7 per cent of saturation, and fluctuated from 6 to 75 per cent, and in about four weeks the contents of the tank were stable on incubation. The average temperature of the sewage was 50° F. in the morning and 53° F. at noon, with a maximum of 61° F. and minimum of 42° F. There was an apparent evaporation of 2.12 inches.

There were many mosquitoes in the covered tank during the first week or two, but they disappeared about November 1. Dissolved oxygen did not appear until a month after filling the tank, and then to a maximum of only 12 per cent of saturation. Stability was reached

in about six weeks, and the tank was emptied on November 17. Nitrification did not occur in either tank. The average temperature of the sewage was 53° F., with a maximum of 60° F. and a minimum of 43° F. In general, the results of the second period of operation of the covered tank were much like the first. In the open tank the growth of *Protococcus* was heavier during the cooler weather of the second period, probably partly due to absence of mosquito larvæ. The green organisms liberate much oxygen which remains dissolved and aids in the purification of sewage, but sewage laden with this growth might, under some conditions of discharge, create offensive conditions.

Average Analyses.

Sewage applied to Open Tank (First Filling).

[Parts in 100,000.]

AMMONIA.			Oxygen consumed.	SUSPENDED SOLIDS.		
Free.	ALBUMINOID.			Total.	Loss on Ignition.	Fixed.
	Total.	In Solution.				
4.80	.85	.22	5.20	9.1	4.1	5.0

Sewage applied to Open Tank (Second Filling).

3.20	.86	.46	4.00	15.5	2.3	13.2
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Open Tank, First Filling, after Fifty-six Days.

.30	.46	.38	2.72	8.6	6.6	2.0
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Open Tank, Second Filling, after Thirty-seven Days.

1.20	.41	.27	2.24	3.4	0.6	2.8
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Sewage applied to Covered Tank (First Filling).

2.80	.64	.39	4.25	12.2	7.1	5.1
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Sewage applied to Covered Tank (Second Filling).

3.00	.60	.14	1.20	10.6	7.8	2.8
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Covered Tank, First Filling, after Sixty-two Days.

3.55	.16	.14	1.02	5.8	2.7	3.1
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Covered Tank, Second Filling, after Forty-two Days.

1.35	.18	.17	1.86	0.7	0.5	0.2
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OPERATION OF TRICKLING FILTERS.

During the year nine trickling filters receiving sewage clarified by sedimentation were continued in operation. These filters are not only operated for special studies, but in order that data from such types of filters may be always available for the use of the Department. One of them, No. 135, has now been in operation for twenty years, longer probably than any other trickling filter in America. It contains 10 feet in depth of pieces of fine broken stone, all of which pass a 1-inch screen, but are retained by a $\frac{1}{4}$ -inch screen, and have an average volume of .52 cubic centimeter. In spite of the fineness of this material it has been necessary to dig over the filter surface to a depth of from 3 to 8 inches only eight times in twenty years. In April, 1918, the upper 18 inches of stone were removed, washed and replaced. The effluent was stable 92 per cent of the time during the year.

THE DEPTH OF FILTERING MATERIAL AND TRICKLING FILTER EFFICIENCY.

In previous reports studies have been elaborated showing the great efficiency and economy of deep compared with shallow trickling filters. In establishing this point, four filters, Nos. 452 to 455, inclusive, have been operated since 1913. These filters are 4, 6, 8 and 10 feet in depth, respectively, and are constructed of broken stone that will pass a $1\frac{1}{2}$ -inch screen and be retained by a $\frac{3}{4}$ -inch screen. During the year all four filters were operated at the same theoretical rate, 1,500,000 gallons per acre daily, and the results are presented in the following table:—

A similar series of filters, Nos. 472 to 475, inclusive, was started in 1915. In this second series the filtering material of broken stone is of a much larger grade than that in the first series, the average volume of the pieces ranging from 25.2 to 29.4 cubic centimeters. These filters, with the exception of No. 474, were operated at such rates that their effluents were of approximately the same quality. The coarse material of these filters gives only about one-half as much surface per foot in depth of filter as the finer material in Filters Nos. 452 to 455, inclusive, and hence sewage passes through them in a correspondingly shorter time, giving a lower purification at a given rate. Filter No. 474 was operated at a high rate the last nine months of the year to furnish a poor effluent for experiments upon activated sludge treatment as a finishing process.

*Average Analyses.**Effluents from Trickling Filters Nos. 135, 452, 453, 454, 455, 472, 473, 474 and 475.*

[Parts in 100,000.]

FILTER NUM- BER.	Quantity applied. Gallons per Acre.	AMMONIA.			Kjeldahl Nitrogen.	Chlorine.	NITROGEN AS —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
		Free.	ALBUMINOID.				Nitrates.	Nitrites.			
			Total.	In Solution.							
135, . . .	1,393,000	3.23	.46	.24	.82	7.2	1.76	.0913	2.76	13.0	850,000
452, . . .	1,368,000	3.38	.67	.35	1.20	8.0	.77	.1790	3.43	14.8	888,000
453, . . .	1,368,000	2.85	.51	.27	.93	8.0	1.74	.0948	2.81	11.2	584,000
454, . . .	1,368,000	2.75	.46	.23	.86	8.0	1.59	.0443	2.80	10.8	644,000
455, . . .	1,368,000	2.64	.39	.24	.77	7.9	1.85	.0457	2.84	10.5	530,000
472, . . .	555,700	3.14	.62	.36	1.09	8.3	1.01	.0701	2.89	15.5	1,271,000
473, . . .	873,000	2.84	.52	.30	.92	8.0	1.41	.0348	2.90	12.0	678,000
474, . . .	5,297,000	2.60	.48	.26	.93	7.7	.44	.0893	3.02	14.0	525,000
475, . . .	1,852,000	2.94	.48	.28	.99	7.9	1.52	.0583	3.00	12.9	636,000

Average Rates and Results. — Trickling Filters.

FILTER NUMBER.	Depth (Feet).	GALLONS FILTERED PER ACRE DAILY PER FOOT OF FILTER DEPTH.		PER CENT OF SAMPLES STABLE.	
		During 1919.	Since Filter was started.	During 1919.	Since Filter was started.
452, ...	4	342,000	—	42	—
453, ...	6	228,000	—	94	—
454, ...	8	171,000	—	100	—
455, ...	10	136,800	—	100	—
472, ...	4	139,000	95,000	56	50
473, ...	6	145,000	115,000	81	76
474, ...	8	662,000	—	—	—
475, ...	10	185,000	151,000	81	84

EXPERIMENTS UPON THE RECOVERY OF SEDIMENT FROM TRICKLING FILTER EFFLUENTS.

Much interest is attached to the sedimentation of trickling filter effluents for improving the effluents of such filters and for recovering material of a fertilizing value. The following table indicates the amount of suspended matter in the sewage applied to all the trickling filters at the station and in their effluents, together with similar figures concerning the sewage applied to activated sludge Tank No. 485, and the sludge from this tank: —

Average Suspended Solids in Trickling Filter Effluents, in applied Sewage and Effluent from Activated Sludge Tank No. 485.

SUSPENDED SOLIDS IN EFFLUENT FROM —	Pounds per Million Gallons.
Filter No. 135, ...	865
Filter No. 452, ...	1,266
Filter No. 453, ...	1,016
Filter No. 454, ...	850
Filter No. 455, ...	857
Filter No. 472, ...	975
Filter No. 473, ...	875
Filter No. 474, ...	825
Filter No. 475, ...	1,016
Settled sewage applied to filters above, ...	1,295
Sewage applied to activated sludge Tank No. 485, ...	1,874
Surplus sludge removed from activated sludge Tank No. 485, ...	1,130

INTERMITTENT SAND FILTERS OPERATED WITH UNTREATED SEWAGE.

Filters Nos. 1, 4 and 9A.

Each of these three sand filters is $\frac{1}{16}$ of an acre in area, and at the end of the year Filters Nos. 1 and 4 had been operated continuously for nearly thirty-two years, while Filter No. 9A had been in operation twenty-nine years. They are probably the oldest regularly operated sewage filters in this country, and are kept in operation to demonstrate the permanency of such filters when properly cared for. Regular station sewage without preliminary clarification has always been

applied to them, and for many years it has been the practice to apply only as much sewage to each filter as can be purified without materially increasing the amount of organic matter stored within the filter. Since 1893, a period of about twenty-six years, all of these filters have been operated without the removal of any sand from their surfaces.

The depth of each filter and grade of sand of which each is constructed, the date when first put into operation, the total volume of sewage treated upon each filter since it was started, and the volume of sewage applied daily during the year are shown in the following table:—

FILTER NUMBER.	Depth (Feet).	Effective Size of Sand (Mil- limeter).	Date first operated.	Actual Volume of Sewage ap- plied since Start (Gallons).	Volume of Sewage ap- plied daily during 1919 (Gallons per Acre).
No. 1, ...	5	.48	Dec. 10, 1888	3,096,600	43,400
No. 4, ...	5	.04	Dec. 19, 1887	1,084,700	18,300
No. 9A, ...	5	.17	Nov. 18, 1890	2,585,200	43,900

For a number of years the surface of Filters Nos. 1 and 9A have been trenched and ridged during the winter and leveled again each spring. The surface of Filter No. 4 is arranged in circular trenches, 14 inches wide, which are filled to a depth of 12 inches with sand of an effective size of .48 millimeters. The sewage is applied to these trenches, grass being permitted to grow on the ridges. In the fall and spring the surface of the filters was dug over to a depth of from 8 to 10 inches. Filters Nos. 1, 4 and 9A were raked to a depth of 1 inch on thirty-one, thirty-four and thirty-four different occasions, respectively, and board coverings were put over the trenches on December 5 and removed on April 7.

An examination of the sand in Filters Nos. 1 and 9A is made about the 1st of July each year, and, as has been previously stated, the greater part of the stored organic matter is in the first foot of sand. As has happened before, there has been a decided reduction in the stored organic matter following an increase in the previous year.

The average analyses of the effluents from these filters are shown in the following tables:—

Sand Analyses.

Albuminoid Ammonia in First Foot of Sand in Filters Nos. 1 and 9A.

[Parts in 100,000.]

YEAR.										Filter No. 1.	Filter No. 9A.
1910,	.	.	.	.	.	.	.	.	.	66.1	56.5
1911,	.	.	.	.	.	.	.	.	.	45.6	65.1
1912,	.	.	.	.	.	.	.	.	.	74.0	83.9
1913,	.	.	.	.	.	.	.	.	.	77.3	74.8
1914,	.	.	.	.	.	.	.	.	.	95.2	76.0
1915,	.	.	.	.	.	.	.	.	.	74.9	81.1
1916,	.	.	.	.	.	.	.	.	.	80.8	70.0
1917,	.	.	.	.	.	.	.	.	.	83.0	79.2
1918,	.	.	.	.	.	.	.	.	.	106.0	86.3
1919,	.	.	.	.	.	.	.	.	.	91.4	68.0

Average Analyses.

Effluent from Filter No. 1.

[Parts in 100,000.]

TEMPERATURE (Degrees F.).		AMMONIA.		Chlor- ine.	NITROGEN AS —		Oxygen con- sumed.	Alka- linity.	Bacteria per Cubic Cen- timeter.
Ap- plied.	Efflu- ent.	Free.	Total Albumi- noid.		Ni- trates.	Ni- trites.			
61	53	.6540	.0667	7.7	3.03	.0062	.63	—1.9	3,420

Effluent from Filter No. 4.

60	52	.1478	.0264	8.5	3.27	.0220	.44	—2.3	140
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Effluent from Filter No. 9A.

60	53	1.1778	.0970	8.0	3.12	.0017	.64	—0.9	19,500
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CHLORINATION. — FILTRATION.

The water supply of Beverly and Salem is taken from Wenham Lake. During the past three years the water in this lake has been added to materially by water taken from the Ipswich River, pumped

during that portion of the year when the flow of the river is above a stated volume. The river water is led through a canal to a pumping station, where it is raised about 20 feet and thence flows by gravity to the lake. Liquid chlorine is added to the water as it enters the pump, and two series of samples were taken during the year to test the efficiency of the chlorination. Some water is also collected in Longham Reservoir, and after chlorination run to the lake by gravity. A table showing the results of this treatment is given beyond.

On July, 1916, an experimental filter, $\frac{1}{117}$ of an acre in area, was put into operation at the lake. This filter is of wood, concrete lined, 10 feet deep, and contains 5 feet in depth of sand of an effective size of 0.27 millimeter, and a uniformity coefficient of 3.3. It has been operated uniformly at a rate of 3,000,000 gallons per acre daily, and many samples, both chemical and bacterial, of the water applied to and of the effluent from this filter were taken during the year, the results of which are shown in a following table: —

Average Bacterial Analyses.

Ipswich River Water before and after Treatment with Chlorine.

DATE.	BEFORE TREATMENT WITH CHLORINE.				Chlorine added. (Parts in 1,000,000).	AFTER TREATMENT WITH CHLORINE.			
	Color.	BACTERIA PER CUBIC CENTIMETER.				Color.	BACTERIA PER CUBIC CENTIMETER.		
		20° C.	37° C.				20° C.	37° C.	
			Total.	Red.				Total.	Red.
1919.									
January 27, . . .	1.14	4,600	195	15	.87	1.07	300	140	8
March 6, ...	.94	1,700	45	-	.60	.91	170	35	-

Longham Reservoir before and after Treatment with Chlorine.

January 27, . . .	.96	6,500	200	50	.60	.96	300	80	10
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*Average Bacterial Analyses.**Results of the Experimental Filter at the Salem Pumping Station.*

1919.	Number of Days tested.	LAKE WATER BEFORE FILTRATION.						LAKE WATER AFTER FILTRATION.					
		BACTERIA PER CUBIC CENTIMETER.			PER CENT OF SAMPLES CONTAINING B. COLI.			BACTERIA PER CUBIC CENTIMETER.			PER CENT OF SAMPLES CONTAINING B. COLI.		
		20° C.	37° C.		0.1 c. c.	1 c. c.	10 c. c.	20° C.	37° C.		0.1 c. c.	1 c. c.	10 c. c.
			Total.	Red.					Total.	Red.			
January,	1	600	6	3	0	0	0	140	4	0	0	0	0
February,	1	200	50	0	0	0	0	10	3	0	0	0	0
March,	1	240	30	0	0	0	0	130	24	0	0	0	0
June,	2	47	5	0	0	0	0	6	2	0	0	0	0
July,	1	24	4	0	0	0	0	23	3	1	0	0	0
August,	1	130	50	4	0	0	0	4	4	1	0	0	0
September,	1	110	6	0	0	0	0	9	5	0	0	0	0
October,	1	120	21	9	0	0	0	20	3	0	0	0	0
Average,	-	184	21	2	0	0	0	43	6	0	0	0	0

LAWRENCE CITY FILTERS.

The city of Lawrence takes its supply of water from the Merrimack River, which is badly polluted by the entrance of sewage and mill wastes of cities and towns above Lawrence. Since 1893, a period of twenty-six years, the city has purified this water by sand filtration.

Two filters are operated, — the older one, constructed in 1893, is 2.2 acres in area and divided into three sections by concrete dividing walls, and contains 4 feet in depth of sand of an effective size of approximately 0.25 millimeter; the other, of modern construction, entirely of concrete, covered, etc., was constructed in 1907. This filter has an area of three-quarters of an acre, and contains about 4½ feet in depth of sand of an effective size of 0.25 millimeter.

The effluents from these filters flow into the same pump-well, and from this they are pumped to a distributing reservoir. During 1917 the easterly section of the old filter was in part reconstructed, a concrete bottom and sides being built; during 1918 this reconstruction was finished, this section being roofed over, and the remaining two sections had all their pipe and gravel underdrains renewed and extended. A certain amount of ground water, high in iron, enters the underdrains of these sections and mixes with the filtered water. The

concrete bottom of the easterly section was built on ground resembling quicksand, and it would not be surprising if cracks developed in the concrete. That this has really happened is indicated by the fact that iron in the effluent is much higher than in the effluent of the other covered filter.

The average volume of water pumped daily from both filters during 1919 was about 4,366,000 gallons. In December, 1918, owing to poor results following the putting into operation of the covered section of the old filter during cold weather, it was thought advisable to chlorinate the water after filtration. A temporary arrangement was made of barrels and a solution of bleach applied directly to the pump-well at the rate of .75 part per million available chlorine. This was continued until May 21, when a liquid chlorine apparatus was installed, which was operated continuously the rest of the year. The average amount of chlorine applied was 0.57 part per million. In the early spring there was an after-growth in the reservoir of bacteria growing at 20° C., but this is not unusual following chlorination of water, and has no sanitary significance.

The average chemical and bacterial analyses of the effluents from these two filters, and of samples from other points on the Lawrence water supply system, are shown in the following tables:—

Average Chemical Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

[Parts in 100,000.]

Temperature (Degrees F.).	APPEAR- ANCE.		AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Iron.	Soap Hardness.
	Turbidity.	Color.	Free.	ALBUMINOID.			Nitrates.	Nitrites.			
				Total.	In Solution.						
51	0.1—	.40	.0165	.0193	.0146	.43	.020	.0008	.56	.0462	0.9

Effluent from Lawrence City Filter (Old Filter).

52	0.1—	.38	.0143	.0094	—	.49	.031	.0003	.39	.1102	1.2
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Effluent from Lawrence City Filter (New Filter).

52	0.1—	.30	.0061	.0083	—	.44	.023	.0002	.38	.0392	1.0
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*Average Chemical Analyses — Concluded.**Water from the Outlet of the Distributing Reservoir.*

[Parts in 100,000.]

Temperature (Degrees F.).	APPEAR- ANCE.		AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Iron.	Soap Hardness.
			Free.	ALBUMINOID.			Nitrates.	Nitrites.			
	Turbidity.	Color.		Total.	In Solution.						
51	0.1—	.39	.0079	.0089	—	.47	.032	.0004	.36	.0725	1.1

Water from a Tap at Lawrence City Hall.

53	0.1—	.40	.0056	.0073	—	.48	.035	.0002	.35	.0752	1.1
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Water from a Tap at the Lawrence Experiment Station.

55	0.1—	.40	.0032	.0077	—	.48	.034	.0001	.36	.0691	1.1
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*Average Bacterial Analyses.**Merrimack River. — Intake of the Lawrence City Filters.*

BACTERIA PER CUBIC CENTIMETER.			PER CENT OF BACTERIA REMOVED.			PER CENT OF SAMPLES CONTAINING B. COLI.				
20° C.	37° C.		20° C.	37° C.		.001 c. c.	.01 c. c.	0.1 c. c.	1.0 c. c.	10 c. c.
	Total.	Red.		Total.	Red.					
15,970	1,120	687	—	—	—	12	75	100	100	—

Effluent from the Lawrence City Filter (Old Filter).

426	14	3	97.3	98.9	99.6	—	—	6	35	62
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Effluent from the Lawrence City Filter (New Filter).

101	6	1	99.4	99.5	99.9	—	—	1	12	50
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Mixed Effluents as pumped to Distributing Reservoir.

189	10	1	—	—	—	—	—	1	19	41
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*Average Bacterial Analyses — Concluded.**Water from the Outlet of the Distributing Reservoir.*

BACTERIA PER CUBIC CENTIMETER.			PER CENT OF BACTERIA REMOVED.			PER CENT OF SAMPLES CONTAINING B. COLI.				
20° C.	37° C.		20° C.	37° C.		.001 c. c.	.01 c. c.	0.1 c. c.	1.0 c. c.	10 c. c.
	Total.	Red.		Total.	Red.					
3,160	13	2	-	-	-	-	-	1	18	44

Water from a Tap at Lawrence City Hall.

1,884	9	1	-	-	-	-	-	1	5	24
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Water from a Tap at the Lawrence Experiment Station.

1,566	18	5	-	-	-	-	-	8	27	48
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DIVISION OF FOOD AND DRUGS

HERMANN C. LYTHGOE, S.B., *Director*



REPORT OF DIVISION OF FOOD AND DRUGS.

During the year 1919 the Food and Drug Division of the Massachusetts State Department of Health has been engaged in the usual routine work relative to the enforcement of the milk, food, drug, cold storage and slaughtering laws, and in the examination of samples submitted by the police authorities. In addition to this the division has been engaged in the manufacturing of arsphenamine.

Mr. Leslie B. Coombs, who was employed in the arsphenamine work as assistant chemist, left the Department to go into commercial work, and his place has not yet been filled. Dr. George L. Drury returned, after a short leave of absence, from the United States army. Mr. Howard D. Williams returned after one year's service in the United States army, and Dr. James M. Kingston returned after two years' service, a great deal of which was spent in France with the 26th Division.

There was an increase of nearly 2,000 samples collected and examined over last year's work, and an increase of nearly 3,000 samples over the work of the year 1917.

The prosecutions are somewhat less in number than during the previous two years, although the fines are nearly as heavy as those imposed last year.

The number of confiscations are slightly more than last year, but slightly less than during the year before.

Of the cases prosecuted, those relating to cold storage were the largest in number, and the cases relating to milk were next in number. Of the milk cases there were 58 convictions for the sale of watered milk; 8 convictions for the sale of milk with a portion of the cream removed; 17 convictions for the sale of milk of low-standard quality; 1 conviction for the sale of skimmed milk without the proper marking on the can; and 1 conviction for the sale of milk containing dirt. Six milk cases were discharged. Of the convicted cases, 2 were for second offence, the balance for first offence. The 17 low-standard cases were brought against restaurant keepers, in all of which cases skimmed milk was served, the fault being with the restaurant and not with the person supplying the milk. The complaints, however, were brought under the low-standard law rather than under the adulteration law. Ten

cases were brought for the sale of decomposed food; 2 of the samples were butter; 2 were fish; 1 was sausage; and 5 were eggs. One each of the fish and egg cases was discharged. The balance of the cases resulted in conviction. Seven convictions were obtained for violation of the special sausage law: in 4 cases the presence of coloring matter was the cause of the complaint, and the other 3 cases were brought by reason of the presence of starch to an extent greater than 2 per cent. Thirteen cases were brought, alleging adulteration of food: 3 of these were for the sale of clams containing added water; 1 for the sale of maple sugar containing cane sugar other than maple; and 9 for the sale of adulterated olive oil. One of the olive oil cases was discharged. Seven cases were brought for misbranding: 1 for the sale of improperly labeled compound coffee; 1 for the sale of strawberry ice cream containing no strawberries; two for the sale of improperly labeled olive oil; and 3 for the sale of stale eggs under the name "fresh eggs." One of the egg cases was acquitted.

For violation of the false advertising law there were 3 cases: 2 relating to eggs and 1 relating to a proprietary drug. The latter case was prosecuted by the chief of police of Palmer. An inspector of this Department obtained most of the necessary evidence and testified at the trial. There were 23 cases for the sale of adulterated drugs, all of which were convicted; 12 of these cases were for the improper labeling of wood alcohol or of denatured alcohol. The other 11 cases were for the sale of drugs not conforming to the requirements of the Pharmacopœia. Seven convictions were obtained under the slaughtering laws: 3 for slaughtering in the absence of the inspector; 2 against inspectors who stamped carcasses which they had not seen killed; and 2 for the sale of unstamped meat. Of the cases involving violation of the storage laws 23 were for holding goods in storage longer than twelve months without the consent of the State Department of Health; 67 were for the sale of cold-storage eggs without the proper label, 3 of which cases were acquitted; 6 cases were for selling cold-storage goods without the proper sign in the store; 1 case was for returning goods to cold storage after they had been placed on the market for sale; and 1 case was for operating a cold-storage warehouse without a license. With the exception of 3 cold-storage egg cases, convictions were secured. There were 3 cases for obstruction of an inspector, all of which were prosecuted and convicted.

The war-time prohibition law has resulted in an enormous increase in the work submitted by police authorities. The work began on the 1st of July, when the act went into effect, and during that month about 800 samples were submitted by the police departments. Since

the Department took over the work in 1904 only 2,200 samples were examined up to June 30 of this year, and since July 1, 1,304 samples have been examined during the present fiscal year. It is therefore very evident that the liquor work has been excessive this year. It was ascertained upon investigation that the privilege of free analysis was being abused in that samples were being submitted by police departments at the request of the United States Internal Revenue Department. This abuse has apparently ceased, though there is still a legitimate increase in the number of liquor samples examined.

Jamaica ginger is the most popular of the unusual preparations utilized by persons who are at present unable to purchase distilled liquor, and who have no reserve supply. There have been various decisions in these cases, resulting mostly in conviction. One particular case in Charlestown was in the nature of a test case, and apparently the court was unable to convict until evidence as to the use of Jamaica ginger was submitted. The testimony was that Jamaica ginger was used as a medicine, as a flavoring extract and as a beverage. The court then held that the testimony of its use as a beverage classed it as an intoxicating liquor as defined by the statute. The court furthermore said that he could take judicial notice of the use of ginger as a beverage by the testimony of the intoxicated persons brought before him, who stated that the intoxication resulted from the ingestion of Jamaica ginger. In a number of instances, however, the defendants were found not guilty under the provisions of an act passed some years ago at the request of pharmacists, which act permits grocers to sell certain specified drugs, among which is specified essence of ginger.

There were 9,576 samples of milk collected and examined during the year. Of these samples 2,699 were below the legal standard; 29 samples were skimmed milk properly labeled; 263 samples were milk from which a portion of the fat had been removed, the milk being sold as pure milk; 369 samples contained added water; and 2 samples contained dirt. Of these samples, 8,661 were obtained from milk dealers, restaurants or stores, and 877 from producers suspected of adulterating the milk which they were selling. Fifty-seven samples were obtained from dairies outside of Massachusetts, 8 of these samples containing added water.

The quality of the milk sold in the State is substantially the same as that furnished during the past two years. The statistics of the Department, however, show less variation in the composition of the average milk, there being more samples found between 12 and 13 per cent of solids, less samples above 13 per cent, and less samples below

11 per cent than in former years. The number of low-standard samples, however, is on the increase, due to the increase in the number of Holstein cows furnishing milk for the Massachusetts market. There does not, however, seem to be any immediate necessity for lowering of the standard, because the average quality of the milk sold is far above our legal standard, and sufficiently high-quality milk can be obtained to offset the low-quality milk furnished by many of the Holstein cattle.

There were 1,382 samples of food examined, including 132 samples of clams, 59 of which contained added water; 352 samples of eggs, of which 227 did not conform to the statute requirements; 188 samples of sausages, 34 of which were either colored or contained starch in excess of 2 per cent; 274 samples of soft drinks, of which 86 contained saccharine; and 75 samples of olive oil, of which 23 contained cottonseed or some other foreign oil. The samples of cider, confectionery, canned corn, evaporated milk, flavoring extract, grapes, maple syrup, spices and vinegar were all found to be pure. The balance of the adulterated samples consisted of 8 samples of rancid butter, representing two shipments; 1 sample of swelled canned goods; 2 samples of watered buttermilk; 1 sample of improperly labeled compound coffee; 1 sample of improperly labeled cocoa, the information in the last instance being referred to the United States Department of Agriculture, resulting in a seizure; 1 sample of condensed milk without the dilution label required by statute; 1 sample of cream below the legal standard; 8 samples of decomposed fish; 4 samples of misbranded ice cream; 1 sample of maple sugar; 3 samples of oysters, containing added water; 1 sample of pears sprayed with arsenic; 4 samples of scallops containing added water; 1 sample of decomposed shrimp; and 3 samples of miscellaneous sugar, containing dirt and salt. These samples of sugar were submitted by the public, and the inspectors were unable to obtain any such samples in the stores against which the complaints were made.

There were 262 samples of drugs examined, of which 79 were adulterated. One sample of bay rum contained wood alcohol; 6 samples of camphorated oil were deficient in camphor; 43 samples of citrate of magnesia contained magnesium sulphate, and the packages were not properly labeled; 29 samples of denatured alcohol did not bear the required label. The samples which were not found to be adulterated consisted of magnesium carbonate, olive oil, paregoric, proprietary medicines, spirit of nitrous ether and witch hazel.

The itinerary of the inspectors was greater this year than during the previous two years, owing to the fact that sufficient appropriation was available for this purpose, and more attention than usual was paid to

the outlying districts as well as to the western part of the State and to the Cape district.

A traveling laboratory was utilized on three automobile trips,—two in the Cape district, and one through the western part of the State. On two different occasions the laboratory of the milk inspector of West Springfield was utilized; on two other occasions the laboratory of the milk inspector of North Adams was utilized, as was also the laboratory of the milk inspector of Barnstable and the laboratory of the Amherst Agricultural Experiment Station. The expense of these trips is very heavy, because the chemist travels with the inspectors, but when one considers the fact that the follow-up work is done without the inspectors returning to Boston to submit the samples for examination, there is a great saving in time, there is a saving in additional railway expense, and there is a great increase in efficiency. Furthermore, by utilizing an automobile it is possible to visit places which would otherwise be almost inaccessible. It is proposed to continue work of this nature during the coming year.

There has been unusual activity this year in cold-storage work, particularly in relation to fish. It is a curious fact that there is more violation of the cold-storage law in relation to fish than to all other articles of food combined. This is due to the fact that the law permits fish to be placed in storage without being labeled as to the date of storage, whereas all other foods must be labeled. Fish can therefore be transferred in cold storage, and there is practically no way of ascertaining the date of original storage, except in a few cases where records have been kept by the owners of the fish. The Food Administration required packages of fish to be dated with the original date of storage, and by reason of this fact we were able to obtain a number of cases of the illegal transfer of fish in cold storage.

The total extensions may be summarized as follows: 87 requests for extensions have been granted; 89 have not been granted; permission was granted on 11 lots to remove goods from storage that had been in storage more than twelve months; and 220 lots were ordered to be removed from storage. Of the 87 extensions granted, 2 were on broken-out eggs, 5 were on butter, 5 were on poultry, 1 was on game, 9 were on meat, 64 were on fish, and 1 was on sweetened condensed milk. Of the 89 extensions not granted, 14 were on broken-out eggs, 8 were on butter, 9 were on poultry, 32 were on meat and 26 were on fish. Of the 11 removals granted, 1 was on poultry, 1 was on game, 4 were on meat and 5 were on fish. Of the 220 lots ordered to be removed, 15 were broken-out eggs, 5 were butter, 22 were poultry, 2 were game, 93 were meat and 83 were fish.

The work of the veterinary inspectors during the year shows that

the business of slaughtering under Massachusetts inspection is, on the whole, carried out in a far more satisfactory manner than ever before since this Department has been enforcing the slaughtering laws. We have succeeded in removing most of the incompetent inspectors, and the local boards have put in their places men who are enforcing the laws in their proper manner. The result of this has been the closing of many slaughterhouses, the owners of these houses stating that they were working in slaughterhouses the inspection of which was not controlled through the Commonwealth of Massachusetts. There are still a number of slaughterhouses in this State which ought to be put out of business, but against which we are unable to get the necessary evidence.

The inspectors of the Department have found it necessary to make 64 confiscations in the cold-storage warehouses; 19 confiscations in stores, factories, etc., and 14 confiscations in slaughterhouses, the total weight of the confiscated articles being 250,462½ pounds.

One of the inspectors was detailed to examine the soft drink factories in this State. The Soda Water Bottlers' Association, for the past two years, has attempted to have a law passed in this State calling for a license system of these factories, with sanitary control by the State Department of Health.

At a legislative hearing last year this Department was asked to submit a statement covering the sanitary condition of these factories, and the Department was unable to do so at that time because inspections had not been made. It was deemed advisable to have inspections made of these establishments during the present year. One inspector was therefore detailed upon this work during the producing season, and visited, in all, 78 such factories. Of these establishments 11 were reported to be in very satisfactory condition; 24 needed only a few slight improvements to put them in a very satisfactory condition; 18 establishments were in poor condition; and 25 establishments were in absolutely unsatisfactory condition.

In the matter of bottles, for example, it was found that many of these places took back bottles from junk handlers, rag pickers, etc.; they used bottles belonging to other bottlers, and, in many instances they were not particular about cleaning these bottles. In 26 establishments mechanical cleaners were used, and in 44 establishments the bottles were cleaned by hand. Forty-seven of these places were reported to clean the bottles in an unsatisfactory manner, and only 23 places cleaned the bottles in a satisfactory manner. In 30 instances the factories were unscreened. In 24 instances the syrups were unprotected from dirt and dust. In 10 instances the syrup room was very

dirty. In 18 instances the lavatories were unscreened, and in 12 instances there were either no facilities or the facilities were inadequate for hand cleaning. In many instances the places were full of rubbish; the work was carried out in kitchens or cellars, as well as in very fine, satisfactory buildings.

In one of these establishments a bottle of corrosive sublimate tablets was found by the inspector. The owner and the employees present were unable to account for the presence of this bottle.

By reason of the unsanitary condition found in many of these factories, it seems advisable for this State to enact the so-called uniform sanitary food law, which is in operation in so many other States. This law provides for the sanitary condition of all establishments where food is manufactured, stored or distributed, and it provides that the materials used in the food shall be protected from contamination in the process of manufacture. The act, as originally proposed, is to be enforced by the State Department of Health, or by the Department enforcing the State food and drug law. It seems, however, feasible in this State that the enforcement of this act should be extended to include the local boards of health, but it also seems desirable that the making of regulations under this act should be confined to the State Department of Health. With an act of this sort on our statute books, this Department, as well as the local boards of health, would be able to enforce cleanliness in the various slaughterhouses, food factories, stores, restaurants, etc., in this State. The act, providing as it does for hearings, would give the proprietors of these establishments plenty of opportunity to put their places in satisfactory shape before it is necessary to take the matter into court.

During the year we have made and distributed 16,027 doses of arsphenamine. Considerable research work has been carried out to improve the process. Effort was expended upon methods for increasing the yield of arsanilic acid, with only moderate success. Research to improve faulty nitration resulted in information relative to purification of the intermediate product next preceding this process. Considerable research upon the preparation of the oxyphenyl-arsonic acid from phenol was carried out and was, in the main, unsatisfactory, although one preparation was made which was satisfactory. Some of this research work has been kept up, and it has been found possible to prepare this compound from phenol upon a laboratory scale, and studies are now being made to put this upon a factory scale because of increased purity of the final product, because of greater yield of finished product, and because of fewer steps in the process of manufacture.

During the latter part of the year investigations have also been made toward the production of neoarsphenamine. We have succeeded in making some of this body, but it is not yet sufficiently pure to be put out.

The present facilities of the Division will be adequate for the production of arsphenamine in sufficient quantities to supply the need of the Department during the coming fiscal year, and, in all probability, we will be able to furnish neoarsphenamine as well.

COLD-STORAGE STATISTICS.

Summary.

Requests for extension of time granted, ...	87
Eggs, ...	2
Butter, ...	5
Poultry, ...	5
Game, ...	1
Meat, ...	9
Fish, ...	64
Condensed milk, ...	1
Requests for extension of time not granted, ...	89
Eggs, ...	14
Butter, ...	8
Poultry, ...	9
Meat, ...	32
Fish, ...	26
Requests for permission to remove granted, ...	11
Poultry, ...	1
Game, ...	1
Meat, ...	4
Fish, ...	5
Articles ordered removed from storage (no requests made), ...	220
Eggs, ...	15
Butter, ...	5
Poultry, ...	22
Game, ...	2
Meat, ...	93
Fish, ...	83

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1918, to Dec. 1, 1919.

[Reason for such extension being that goods were in proper condition for further storage.]

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Egg whites, ...	4,000	Mar. 14, 1918	Aug. 15, 1919	Berwick Cake Company.
Egg yolks, ...	17,000	Apr. 22, 1918	Aug. 15, 1919	Berwick Cake Company.
Butter, ...	3,025	June 5, 1918	June 25, 1919	British Ministry of Shipping.
Butter, ...	2,773	June 15, 1918	June 24, 1919	British Ministry of Shipping.
Butter, ...	2,945	June 15, 1918	June 25, 1919	British Ministry of Shipping.
Butter, ...	40	June 12, 1918	Oct. 1, 1919	Butler, Alfred M.
Butter, ...	40	July 8, 1918	Sept. 8, 1919	Hunneman, William C.
Broilers, ...	1,642	July 31, 1918	Sept. 25, 1919	Eastman, Frank B.
Chickens, ...	95	Nov. 29, 1918	Mar. 1, 1920	Mailman, Charles.
Chickens, ...	120	Dec. 10, 1918	Feb. 1, 1920	Morgan, Fred L.
Fowl, ...	300	Dec. 10, 1918	Feb. 1, 1920	Morgan, Fred L.
Turkeys, ...	7,547	Jan. 3, 1918	Feb. 17, 1919	Dorr, Arthur E., & Co., Inc.
Deer, ...	160	Oct. 25, 1918	Jan. 25, 1920	Freeman, B. A.
Beef, ...	2,275	Nov. 20, 1918	Dec. 31, 1919	Dorr, Arthur E., & Co., Inc.
Beef, ...	448	May 9, 1918	Aug. 9, 1919	Prendergast, William J.
Beef, ...	461	May 21, 1918	Aug. 21, 1919	Prendergast, William J.
Beef, ...	203	Mar. 30, 1918	June 30, 1919	Prendergast, William J.
Beef, ...	6,850	Nov. 14, 1918	Dec. 31, 1919	Dorr, Arthur E., & Co., Inc.
Beef kidneys, ...	1,980	May 27, 1918	July 15, 1919	Hollis, N. E. & Co.
Beef rounds, ...	1,403	Jan. 22, 1918	Apr. 1, 1919	Bay State Fishing Company.
Ox tails, ...	10,710	Sept. 10, 1918	Dec. 15, 1919	Swift & Co.
Pork livers, ...	10,000	Mar. 9, 1918	May 9, 1919	Dorr, Arthur E., & Co., Inc.
Halibut, ...	7,600	July 8, 1918	Aug. 8, 1919	McKay, Robert S.
Halibut, ...	4,737	Oct. 30, 1918	Dec. 31, 1919	New England Fish Company.
Halibut, ...	5,148	Oct. 30, 1918	Dec. 31, 1919	New England Fish Company.
Halibut, ...	4,447	Nov. 1, 1918	Dec. 31, 1919	New England Fish Company.
Halibut, ...	5,168	Nov. 2, 1918	Dec. 31, 1919	New England Fish Company.
Halibut, ...	5,018	Nov. 8, 1918	Dec. 31, 1919	New England Fish Company.
Halibut, ...	2,783	Nov. 5, 1918	Dec. 5, 1919	T Wharf Fish Company.
Halibut heads, ¹	1,200	Feb. 12, 1918	May 1, 1919	New England Fish Company.
Herring, ¹	7,525	May 7, 1918	Nov. 1, 1919	Atlantic & Pacific Fish Com- pany.
Herring, ¹	8,450	May 10, 1918	Nov. 1, 1919	Atlantic & Pacific Fish Com- pany.
Herring, ...	2,520	June 22, 1918	Jan. 1, 1920	Atwood & Co.
Herring, ¹	2,200	May 3, 1918	Aug. 1, 1919	Bay State Fishing Company.

¹ For bait.

Requests for Extension of Time Granted on Goods in Cold Storage from Dec. 1, 1918, to Dec. 1, 1919 — Continued.

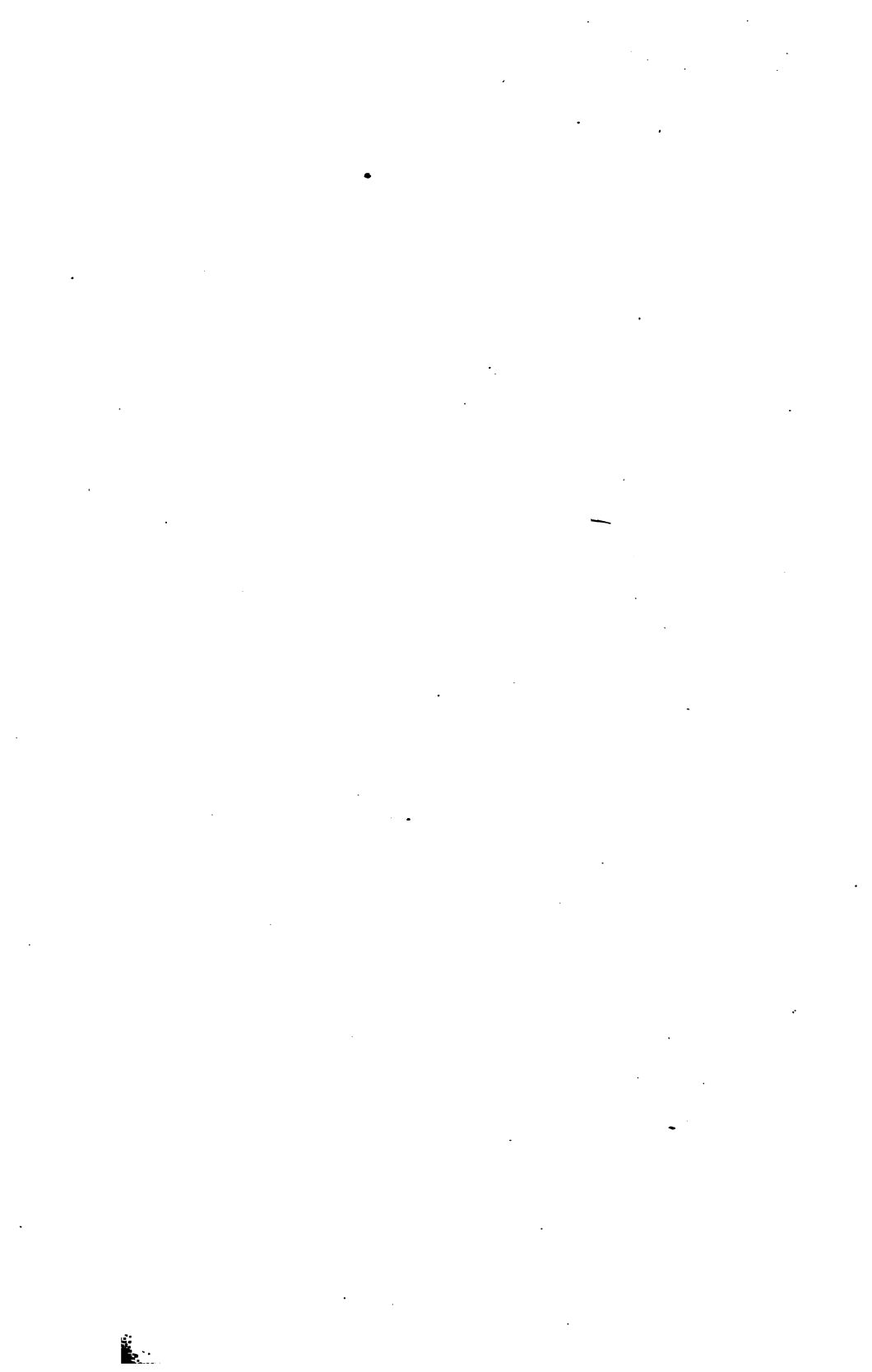
ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Herring, ...	2,000	Feb. 28, 1918	June 1, 1919	Bay State Fishing Company.
Herring, ¹	6,000	May 8, 1918	Aug. 1, 1919	Bay State Fishing Company.
Herring, ¹	1,767	May 13, 1918	Aug. 1, 1919	Bay State Fishing Company.
Herring, ¹	13,600	May 16, 1918	Aug. 1, 1919	Bay State Fishing Company.
Herring, ¹	33,000	May 22, 1918	Sept. 1, 1919	Bay State Fishing Company.
Herring, ¹	8,600	May 29, 1918	Sept. 1, 1919	Bay State Fishing Company.
Herring, ¹	11,850	May 30, 1918	Aug. 1, 1919	Bay State Fishing Company.
Herring, ...	1,400	June 6, 1918	Oct. 1, 1919	Bay State Fishing Company.
Herring, ...	1,800	June 7, 1918	Oct. 1, 1919	Bay State Fishing Company.
Herring, ...	1,800	June 10, 1918	Nov. 1, 1919	Bay State Fishing Company.
Herring, ...	40,000	June 10, 1918	Nov. 1, 1919	Bay State Fishing Company.
Herring, ...	6,800	June 12, 1918	Nov. 1, 1919	Bay State Fishing Company.
Herring, ...	10,800	June 26, 1918	Dec. 1, 1919	Bay State Fishing Company.
Herring, ¹	14,280	July 12, 1918	Mar. 1, 1920	Bay State Fishing Company.
Herring, ¹	36,000	July 12, 1918	Dec. 1, 1919	Bay State Fishing Company.
Herring, ¹	400	Oct. 14, 1918	Dec. 14, 1919	Bay State Fishing Company.
Herring, ¹	1,000	Nov. 6, 1918	Dec. 31, 1919	Bay State Fishing Company.
Herring, ¹	90,000	May 29, 1918	July 29, 1919	Boston Fish Pier Company.
Herring, ¹	130,000	May 29, 1918	Dec. 1, 1919	Cape Cod Cold Storage Com- pany.
Herring, ...	98,200	May 19, 1918	Jan. 1, 1920	Consolidated Weir Company.
Herring, ...	2,164	Oct. 10, 1918	Dec. 30, 1919	Harding, F. E., Company.
Herring, ¹	7,600	July 12, 1918	Nov. 12, 1919	O'Brien, R., & Co.
Herring, ¹	5,000	June 2, 1918	Nov. 1, 1919	Rutstein, B., & Sons Com- pany.
Herring, ¹	6,880	June 2, 1918	Nov. 1, 1919	Rutstein, B., & Sons Com- pany.
Herring, ¹	16,342	July 23, 1918	Dec. 1, 1919	Rutstein, B., & Sons Com- pany.
Maakeral, ...	30,722	July 5, 1918	Aug. 5, 1919	Boston Fish Pier Company.
Maakeral, ...	38,691	July 10, 1918	Aug. 10, 1919	Boston Fish Pier Company.
Maakeral, ...	5,600	July 17, 1918	Aug. 17, 1919	Boston Fish Pier Company.
Maakeral, ...	34,654	July 26, 1918	Aug. 26, 1919	Boston Fish Pier Company.
Maakeral, ...	15,700	Aug. 21, 1918	Dec. 31, 1919	Boston Fish Pier Company.
Maakeral, ...	5,820	Oct. 3, 1918	Dec. 30, 1919	Boston Fish Pier Company.
Maakeral, ...	2,100	Oct. 22, 1918	Dec. 31, 1919	Boston Fish Pier Company.
Maakeral, ...	840	June 11, 1918	Dec. 1, 1919	O'Brien, R., & Co.
Maakeral, ...	3,000	June 11, 1918	Dec. 1, 1919	O'Brien, R., & Co.
Maakeral, ...	3,600	June 27, 1918	July 27, 1919	O'Brien, R., & Co.

¹ For bait.

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1918, to Dec. 1, 1919 — Concluded.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Mackerel, ...	1,110	July 1, 1918	Aug. 1, 1919	O'Brien, R., & Co.
Mackerel, ...	2,040	July 1, 1918	Aug. 1, 1919	O'Brien, R., & Co.
Pollock, ...	60,000	Nov. 12, 1918	Dec. 30, 1919	Boston Fish Pier Company.
Smelts, ...	13,638	Jan. 16, 1918	Feb. 16, 1919	Boston Fish Pier Company.
Smelts, ...	800	Jan. 29, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Smelts, ...	2,080	Jan. 29, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Smelts, ...	8,840	Jan. 29, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Smelts, ...	150	Feb. 2, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Smelts, ...	1,630	Feb. 2, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Smelts, ...	3,560	Feb. 2, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Smelts, ...	23,560	Feb. 2, 1918	Mar. 1, 1919	Boston Fish Pier Company.
Squid, ¹	1,100	Jan. 12, 1918	Apr. 12, 1919	Atlas Fish Company.
Squid, ¹	1,080	Nov. 22, 1917	Dec. 22, 1918	Prevoir, Frank.
Squid, ¹	650	Nov. 24, 1917	Dec. 24, 1918	Prevoir, Frank.
Squid, ¹	20,000	Mar. 5, 1918	Apr. 5, 1919	Prior & Mahoney.
Whiting, ...	2,200	Oct. 10, 1918	Dec. 30, 1919	Harding, F. E., Company.
Whiting, ...	90,000	Nov. 19, 1918	Jan. 30, 1919	Martha's Vineyard Cold Storage and Ice Company.
Sweetened condensed milk,	36,000	Jan. 25, 1918	Apr. 25, 1919	Worcester Baking Company.

¹ For bait.



DIVISION OF COMMUNICABLE DISEASES

BERNARD W. CAREY, M.D., *Director*

REPORT OF DIVISION OF COMMUNICABLE DISEASES.

The value of the District Health Officer is becoming more and more apparent. The concrete results of his endeavors to raise the public health standards of the State are shown with increasing frequency.

The procedures which were formerly thought to belong to the special investigator of communicable disease are now regularly undertaken by the local boards of health. Carriers of typhoid and of diphtheria (with differentiation of the virulent from the non-virulent group) and outbreaks on milk farms are among the epidemiological investigations which are receiving closer attention from the local investigator. This, it is believed, is one of the direct results of the District Health Officer's endeavors.

As a generalist in public health the District Health Officer has instituted movements which have greatly increased the efficiency of health administration. The placing of public health nurses in the smaller communities, the institution of health weeks with numerous lectures to interested audiences, differential diagnosis for the physicians, together with advice to local boards of health as to their action in a given condition or perhaps controversy, are but few of his duties.

The evidences of unrest so prevalent among all people at this time as an aftermath of the war and disturbed economic conditions have existed among our personnel. We have lost efficient District Health Officers for the sole reason that they could not support themselves and their families upon the salary paid, and we were likewise unable to interest suitably trained physicians in our service because of the low rate of recompense. Examinations have been advertised to fill vacancies, with an insufficient number of qualified men appearing to allow a choice to be made or even to complete our staff. It appears that some financial relief must be offered if we are to retain the District Health Officers who are now with the Department, or to obtain qualified officers to fill vacancies as they may occur.

The nursing assistant continues to prove the wisdom of the establishment of her position. Groups of women, children and nurses have been amenable to her suggestions that could not have been reached

in any other way. Her faithful, conscientious efforts in the follow-up work of the tuberculous alone justify her existence, and her interest in co-operative effort with other nursing agencies furnishes the Department with a contact that has limitless possibilities for community welfare.

BACTERIOLOGICAL LABORATORY.

The number of specimens examined during the year has exceeded that done for any previous year.

The total number of all kinds of examinations made follows: —

	DIAGNOSIS.		RELEASE.		Atypical.	Total.
	Positive.	Negative.	Positive.	Negative.		
Diphtheria, ...	1,366	8,463	1,641	3,455		14,925
Tuberculosis, ...	949	2,800				3,749
Typhoid fever: —						
Widal test, ...	370	1,171			81	1,622
Culture test, ...	59	491				550
Gonorrhea, ...	417	3,610				4,027
Malaria, ...	3	88				91
Pneumonia, ...						497
Miscellaneous, ...						293
Total, ...						25,754

To overcome the delay of specimens which occurs in the mail, to stimulate more accurate diagnosis of communicable diseases, and to insure their earlier treatment where positive laboratory findings are shown, it is recommended that a bacteriological laboratory in the western section of the State, preferably at Springfield, be established.

The special studies that our bacteriologist is making on diphtheria in its relation to the carrier in the home or school are progressing favorably. Marked co-operation of local health and school authorities has been shown, and it is believed that the scientific data obtained, as well as the material benefit rendered to these children, will make this work of real and lasting value.

The following table gives the total number of biological products and diagnostic outfits distributed by the State Department of Health from the bacteriological laboratory from Dec. 1, 1918, to Nov. 30, 1919: —

Diphtheria antitoxin:—

12,000 units (for the Boston City Hospital),	1,794 bottles.
12,000 units,	592 bottles.
6,000 units (for the Boston City Hospital),	422 bottles.
6,000 units,	4,087 bottles.
3,000 units,	34,861 bottles.
2,000 units (for the Boston City Hospital),	238 bottles.
1,000 units,	10,157 bottles.

Smallpox vaccine:—

Capillary tubes,	184,973
Bulk,	8,025 cubic centimeters.

Typhoid vaccine:—

Ampoules,	7,762
Bulk,	9,450 cubic centimeters.

Typhoid-paratyphoid vaccine:—

Ampoules,	12,050
Bulk,	44,500 cubic centimeters.

Paratyphoid vaccine:—

Ampoules,	1,381
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Antimeningitis serum, ... 4,399 bottles.

Silver nitrate solution, ... 52,108 ampoules.

Diagnostic Outfits.

Diphtheria culture outfits,	18,203
Tuberculosis sputum bottles,	5,378
Pneumonia outfits,	424
Widal outfits,	1,954
Typhoid culture outfits,	855
Malaria-gonorrhea outfits,	2,535

INSPECTION OF HOSPITALS.

Routine inspections of hospitals for the year have been made, and the conditions found show that in the main the hospitals of our State are being conducted in such a manner as to protect the public health.

DISPENSARIES.

Under chapter 131 of the General Acts of 1918 all dispensaries of the State were inspected and recommendations made for their proper licensing. There have been 32 licenses granted and 5 refused.

Investigation by the District Health Officers showed that in no instance where the dispensary license was denied was the public health likely to be conserved nor had public benefit resulted from the operation of the dispensary.

JAILS AND LOCK-UPS.

The yearly inspections of jails and lock-ups were made, and in most instances the places were found to be in fair sanitary condition.

It is a notable fact, however, that the recommendations made at the time of the inspections are seldom carried out, and each year finds the same insanitary conditions existing where they were present the previous year.

SUBDIVISION OF TUBERCULOSIS.

The work of the subdivision of tuberculosis has continued along the same general lines as in other years.

There has been a lessened attendance at the tuberculosis dispensaries, due perhaps to the same factors which lessened the number of patients at the tuberculosis sanatoria, namely, the high wages obtainable in our manufacturing plants, and the natural unrest which arose from abnormal conditions.

Some means must be devised to raise the standard of follow-up work to bring under regular medical supervision contacts and the children who live in the homes of the tuberculous.

The regular tuberculosis dispensary inspection for the year shows that in the main the records are well kept, the personnel interested, and few patients in attendance.

An additional factor to account for the falling off of attendance at the dispensaries may be that, because of the increased wage which the laboring man is now receiving, there are more tuberculous attended by private physicians. It is also believed that our people do not know as much about our tuberculosis dispensaries as they should, and therefore do not utilize them. It is hoped that by greater publicity the attendance at our clinics will increase.

The tuberculosis survey of the city of Cambridge, started July 1, 1918, which was interrupted because of the pandemic of influenza, has been completed. The facts brought out are comparable with those of cities of the same population and industry where insufficient financial aid has been given to the local board of health. If the tuberculosis activities of a given community are to be economically and efficiently carried out, there must be a sufficient amount of financial aid available.

The control and prevention of tuberculosis in a large measure is in the hands of the follow-up worker, for upon her ability to supervise patients, contacts, and with sympathetic interest to reach the suspected cases, lies our future.

SUBDIVISION OF VENEREAL DISEASES.

The subdivision of venereal diseases is striving to maintain the impetus given to venereal disease activities by the war conditions, and, judging by the reports of incidence of these diseases, the increased attendance at the clinics, and the number of lapsed cases returning to treatment, it is fair to state that this work is giving permanent results.

During the year sixteen clinics have been placed in operation throughout the State, giving a total number of treatments of 26,087. Of this number, however, 22,598 were received in Boston, and 3,489 in the remaining clinics of the State.

It is believed that wider advertising of our clinics will result in a much larger attendance, and from this attendance and from the number of patients under the supervision of private physicians the success of the venereal disease movement must be judged.

Thirty-seven lectures have been given to selected audiences; 17,963 pamphlets distributed; physicians and pharmacists circularized with special literature; and 10,822 ampoules of arsphenamine distributed to clinics, hospitals and physicians for the treatment of syphilis.

CHANGES IN PERSONNEL.

The following changes in personnel have occurred in our staff during the year: —

- January 15. Miss Katharine M. Turner appointed nursing assistant in the Berkshire Health District.
- April 1. Miss Bernice W. Billings resigned as chief of the subdivision of tuberculosis.
- April 24. Miss Bertha C. Lovell appointed as special investigator in the subdivision of venereal diseases.
- May 1. Dr. John J. Carroll resigned as chief of the subdivision of venereal diseases.
- June 1. Dr. John S. Hitchcock resigned as director of the division.
- June 1. Dr. Bernard W. Carey appointed as director of the division.
- June 1. Dr. George H. Bigelow appointed as acting epidemiologist.
- July 1. Dr. Howard A. Streeter resigned as District Health Officer of the Berkshire Health District and appointed as chief of the subdivision of venereal diseases.
- July 29. Dr. James A. Keenan appointed as Acting District Health Officer of the Berkshire Health District.
- August 1. Dr. Stanley H. Osborn, epidemiologist, returned from military service.
- August 26. Mr. H. C. Mosman appointed as inspector in the subdivision of venereal diseases.

- September 1. Miss Mary C. Hoisington resigned as nursing assistant of the Southeastern Health District.
- September 1. Dr. George H. Bigelow resigned as acting epidemiologist.
- September 1. Mr. Charles Clark appointed as special investigator in the subdivision of venereal diseases.
- October 1. Dr. Russell B. Sprague resigned as District Health Officer of the Eastern Health District.
- October 1. Dr. George T. O'Donnell transferred to the Eastern Health District from the Connecticut Valley Health District.
- November 10. Dr. Bertrand E. Roberts appointed as District Health Officer of the Connecticut Valley Health District.
- November 15. Dr. Arthur A. Brown resigned as District Health Officer of the South Midland Health District.
- November 17. Miss Katherine B. O'Connor appointed as nursing assistant in the Southeastern Health District.

SPECIAL ACTIVITIES.

During the year certain activities have been undertaken, either to perfect plans and procedures already in existence, or along altogether new lines.

To increase morbidity reports by physicians, and to have these reports more uniform with those of the other States, the agents or members of local boards of health, through the co-operation of the United States Public Health Service, are to be appointed assisting collaborating epidemiologists, and will be privileged to use franked postal cards for the reporting of communicable diseases to the District Health Officer and to this office. A wider distribution of cards will be effected, with the result that more cases will be reported.

Arrangements have been made with the Association of Hospital Superintendents for courses of lectures upon public health topics for the nurses in their training schools. This is a most important step, and one which should react for a great improvement in public health in the communities in which nurses may locate.

Lectures were given at vacation camps for boys and girls upon personal hygiene and general public health subjects.

A special campaign against diphtheria has been instituted, based upon a statistical study of 1,000 deaths which were investigated by the District Health Officers. As the largest single factor in the causation of these deaths appeared to be the non-realization of the necessity of early diagnosis and treatment, our efforts have been directed toward wider publicity for our facts, using the press, the medical journals, lectures to women's organizations and other interested bodies. Papers

before medical societies and a special bulletin for school children have been prepared and delivered.

At the present time a special diphtheria investigation is being carried out to ascertain what may be the carrier incidence in both the school and the preschool age groups, what percentage of these carriers may harbor virulent organisms as shown by the virulence test, and what percentage of children may show pathological conditions of the naso-pharynx which might possibly account for this carrier state.

Our epidemiologist has prepared special follow-up letters to physicians urging them to use prophylactic typhoid vaccination, and to the families telling of its value. It appears as though the more widespread use of typhoid vaccine is the greatest single factor left us to reduce the incidence of typhoid fever in this State.

Efforts have been made to have the inmates of prisons receive a thorough examination, paying particular attention to venereal and tubercular conditions. It is hoped that this work for the tuberculous may be done by experts, and, through the co-operation of the Prison Bureau, that they may be transferred to the Prison Camp at Rutland for their proper treatment.

Arrangements were made during the year with the county commissioners of Plymouth County to care for the patients whose names are on the waiting list for the State sanatoria. It is hoped that this will provide treatment for a large number of people who otherwise would not have the advantage of hospital care, and who might be infecting the inmates of their homes during this prolonged period of waiting.

A special study to determine the value of serum treatment for influenza-pneumonia was carried out during the latter part of the influenza outbreak. Physicians were trained in the preparation and administration of sera obtained from convalescent influenza-pneumonia patients at the Chelsea Naval Hospital under the direction of Dr. Redden and Dr. Maguire. Owing to the fact that we entered this special field of therapy at the end of the outbreak our results were limited. It is believed, however, that the administration of convalescent sera of influenza given early is an efficacious agent for the treatment of influenza-pneumonia. The thanks of this Department are extended to Dr. Redden and Dr. Maguire for this splendid co-operation.

NEW RULES AND REGULATIONS AFFECTING THE DIVISION.

March 13, 1919. An act amending chapter 286 of the General Acts of 1916, extending the time in which tuberculosis hospitals shall be built, and requiring one hospital bed for each four deaths rather than one bed for each two deaths.

Nov. 7, 1919. The Public Health Council amended the minimum requirements for tuberculosis dispensaries to include certain requirements for dispensary nurses.

April 1, 1919. Regulations for the reporting of venereal diseases revised.

RECOMMENDATIONS.

It is especially recommended that consulting service, for tuberculosis in particular, be afforded to the rural communities. A traveling clinic as suggested by Dr. Francis A. Finnegan might accomplish this, and even furnish diagnostic aid for all of the communicable diseases and further our special activities, such as the child conservation movement.

REPORT OF THE EPIDEMIOLOGIST FOR THE YEAR ENDING NOV. 30, 1919.

Interstate and International Reciprocal Notifications.

The United States Public Health Service form is now used for notification in cases of disease occurring in Massachusetts which originate in other States, and in Canada, or of residents of other States who have been in contact with disease in Massachusetts. There were 49 such notifications sent during 1919. Of this number, 4 were relative to cases of anterior poliomyelitis, 3 were of cases of smallpox, and 42 were relative to cases of typhoid fever.

Outbreaks and Epidemics.

Since January the following outbreaks have been investigated by the District Health Officers:—

DISEASE.	Number of Outbreaks.	Number of Cases.
Scarlet fever, ...	16	530
Diphtheria, ...	12	464
Measles, ...	9	662
Whooping cough, ...	2	94
Typhoid fever, ...	10	143
	49	1,893

Diseases on Premises of Milk Handlers.

There were 22 instances of illness reported as existing on farms producing milk or on premises of a milk dealer. Immediate investigation of these cases and the carrying out of prompt precautions, advised by

local boards of health and State District Health Officers, assisted in preventing the further spread of diseases through the medium of milk.

At the present time cases of scarlet fever, dysentery, tonsillitis, diphtheria and typhoid fever on premises of milk handlers are required to be reported to the State Department of Public Health at once.

The following table gives the total cases of disease for the period covered:—

Relative Occurrence of Principal Reportable Diseases.

DISEASE.	1918.	1919.	Increase.	Decrease.
Influenza, ...	145,262	40,222	—	105,040
Measles, ...	29,215	9,985	—	19,230
Gonorrhea, ...	7,681	9,435	1,754	—
Scarlet fever, ...	4,490	8,018	3,528	—
Diphtheria, ...	6,922	7,929	1,007	—
Tuberculosis (pulmonary), ...	7,833	6,977	—	856
Chicken pox, ...	4,117	6,693	2,576	—
Whooping cough, ...	7,765	5,727	—	2,038
Lobar pneumonia, ...	13,374	4,585	—	8,789
Syphilis, ...	3,284	4,127	843	—
Mumps, ...	4,972	3,497	—	1,475
Ophthalmia neonatorum, ...	1,877	1,687	—	190
Typhoid fever, ...	1,067	938	—	129

Typhoid Bacilli Carriers.

There were 13 typhoid carriers located during 1919. The search for typhoid bacilli carriers is now practically a routine procedure by all progressive health officials in the State. A few, however, do not yet realize the danger of the carrier, and that he is the chief factor in causing typhoid fever in Massachusetts. Many hospitals are carrying out as a routine procedure the fecal and urine examinations of convalescent typhoid patients before discharging them. All hospitals should do this to be sure that the patient will not return home and infect other members of the household.

Every carrier found in 1919 had a positive Widal test. The 13 carriers were apparently responsible for 57 cases of typhoid fever in 1919, 2 cases in 1918, 33 cases in 1913, 2 cases in 1912, 2 cases in 1911, 2 cases in 1908 and 5 cases in 1907.

The summary of the carriers is given in the accompanying tabular review.

Typhoid Bacilli Carriers located during 1919.

Locality.	Sex.	Occupation.	Type of Carrier.	Cases infected.	Remarks.
1. New Bedford,	Female,	Housewife,	Fecal B. Typhosus isolated in February.	1	Had typhoid in October, 1918. One case occurred in her household.
2. Somerville,	Female,	Housewife,	Fecal B. Typhosus isolated in April and June.	2	No history of carrier ever having had typhoid. Two cases occurred in her household in 1919, and 2 in 1918.
3. Needham,	Female,	Housemaid,	Fecal B. Typhosus isolated in May and June.	1	Had typhoid in 1914. One case occurred in household where she was employed.
4. Quincy,	Male,	Mechanic,	Fecal B. Typhosus isolated in June.	1	One case occurred in his household.
5. Randolph,	Male,	Milk handler,	Fecal B. Typhosus isolated in July.	8	There were 8 cases on his milk route.
6. Templeton,	Male,	Milk handler,	Urinary B. Typhosus isolated in August.	8	Templeton carrier had typhoid in 1913. Westminster carrier stated she never had typhoid. There were 8 cases on a milk route in Gardner and these 2 carriers were found supplying milk to the dealer on whose route the cases occurred.
7. Westminster,	Female,	Milk handler,	Fecal B. Typhosus isolated in August.		Had typhoid in February, 1919. One case occurred in household in August, 1919.
8. Lawrence,	Female,	School,	Fecal B. Typhosus isolated in August.	1	Had typhoid in 1906. There were 29 cases on route of milk dealer in Worcester to whom carrier sold milk, produced on his farm.
9. Princeton,	Male,	Milk handler,	Fecal B. Typhosus isolated by Worcester board of health in October.	29	Carrier on milk farm had been associated with 44 cases of typhoid in years 1907-13, inclusive, though no bacteriological evidences were obtained during that period.
10. Manchester, N. H.,	Male,	Milk handler,	Fecal B. Typhosus isolated by New Hampshire board of health, Concord, N. H., in October.	3	Cases of typhoid were reported from Arlington, Medford and Boston, and from information furnished on the typhoid case records received from the local boards of health, the New Hampshire board of health was notified and a carrier found on the farm supplying milk to the hotel with the cases had visited.
11. Arlington,	Female,	Housewife,	Fecal B. Typhosus isolated in November.	1	Had typhoid in 1901. One case occurred in her household.
12. Newton,	Male,	Student,	Fecal B. Typhosus isolated in November.	1	One case occurred in her household.
13. Brookline,	Female,	Cook,	Fecal B. Typhosus isolated in November.	1	Had typhoid in 1903. One case occurred in her household.
					Had typhoid in 1915. One case occurred in household.

Measles.

DATE.	Locality.	Cases.	Method of Infection.	Brief History of the Disease.
January and June, ...	Leominster, ...	154 32	Contact. Lack of medical care.	The two outbreaks resulted because many cases had no physician and thus spread the disease by going about the community with the disease undiagnosed.
April to June, ...	Westport, ...	47	Contact, ...	The cases were in children and not confined to any special district.
May and June, ...	Winchendon, ...	42	School contact. Unrecognized cases.	Many children attended school with the mild type of the disease, no physician being in attendance.
June and July, ...	Saugus, ...	39	School contact. Unrecognized cases.	Most of the cases were in school children, but no particular school had an undue proportion of cases. Mild and unrecognized cases were found to be the cause of the outbreak.
June and July, ...	Tisbury, ...	38	Contact. Unrecognized cases.	Investigation showed the first case of measles was called German measles, and because of shorter quarantine and the early release the cases spread.
September and October, ...	New Bedford, ...	102	School contact, ...	Investigation showed the increase in cases started soon after the opening of school and was confined to one-half of the city.
September and October, ...	Oak Bluffs, ...	27	School contact, ...	The increase in cases followed the opening of school, and mild cases, before they were recognized, infected other children.
October and November, ...	Danvers, ...	86	Contact, ...	There have not been many cases of measles in this town for several years, and for this reason there were many non-immunes among the children.
November, ...	Townsend, ...	75	Contact, ...	The cases were confined chiefly to foreign quarters of the village.

Whooping Cough.

DATE.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
July, ...	Great Barrington, ...	16	Contact, ...	Investigation showed that quarantine was not properly carried out by householders.
July, ...	Pittsfield, ...	78	Contact, ...	The disease prevailed all over the city, and many cases had no physician and thus were not reported or quarantined.

Scarlet Fever.

December through February, ...	Gloucester, ...	78	School contact, ...	Lack of quarantine, or delay in placing same, and mild cases were responsible for the outbreak.
December through May, ...	Revere, ...	54	Contact, ...	No particular cause was found for the increase in cases.
January, ...	Westfield, ...	17	Contact, ...	Mild and unrecognised cases were found on investigation. Increased precautions were recommended in isolating mild cases.
February and March, ...	Holyoke, ...	48	Contact, ...	The disease was of a mild type, and many cases were in children who had influenza a few months before.
April and May, ...	Milford, ...	40	Contact, ...	No common source was found, and the cases were scattered in the community.
May through July, ...	Falmouth, ...	8	Contact, ...	Investigation showed the cases to be in two separate parts of the town.
May through July, ...	Revere, ...	13	Contact. Unrecognised cases, ...	Missed or unrecognised cases were found to be the cause of the increase in cases reported.
May, ...	Ashburnham, ...	2	School contact. Unrecognised cases, ...	The cases were confined to a single school, and unrecognised cases were found in school on investigation. Cases were not reported.
June, ...	Ayer, ...	13	Contact, ...	No cause was ascertained, the cases being distributed all over the town.

September through December, .	Lynn, .		283	Contact, Quarantine not ob- served.	A careful investigation by the local board of health showed a lack of isolation and observance of quarantine of cases. Pupils were allowed to attend school from houses where the disease existed.
September through December, .	Lowell, .		174	Contact. Unrecognised cases,	Unrecognised cases of the mild type of the disease seemed to be the cause of the high incidence of the disease.
October, ...	Templeton, .		7	School contact, ...	Cases were found in the desquamation stage attending school, and parents had hidden cases at home to avoid quarantine.
November and December, .	Framingham, .		30	Contact, ...	Mild and unrecognised cases of the disease caused other cases.
October through December, .	Cambridge, .		86	School contact. Unrecognised cases.	The local investigation disclosed many mild cases and children in school with symptoms of the disease. Increased activities of the local board are locating many foci.
November and December, .	Newton, .		67	School contact, ...	Inquiry by the local board into the first 4 cases resulted in the finding of 17 cases that had no physician and were not reported to the local board of health. All of the cases were scattered, except a group in the foreign population in the Nonantum section.
October through December, .	Easthampton, .		44	School contact, ...	Most of the cases were in the foreign population. Extra work carried on among this population was effective in checking the disease.

Diphtheria.

January, ...	Westfield, .		22	Contact, ...	Cases were scattered in the community and no particular reason was found for the increase.
January and February, .	Danvers, .		12	Contact, ...	Investigations showed three cases in one family, and two in another, but no central focus of the disease was discovered.
February, ...	Northampton, .		11	Contact. Quarantine not ob- served.	A lack of observance of quarantine was found in homes where diphtheria was present.
February and March, .	Marlborough, .		4	School contact, ...	All the cases were in the same school. Culturing the pupils in the school and elimination of the incipient cases prevented the spread of the disease.

Diphtheria — Concluded.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
March and April, ...	Orange, ...	9	School contact, ...	All cases were in one schoolroom. Two unrecognized cases were found by culturing the room.
September and October, ...	Haverhill, ...	33	Contact, ...	No particular reason was found for the continued spread of the disease.
September through December, ...	Lynn, ...	227	Contact. Unrecognized cases. Quarantine not observed. . . .	Unrecognized and mild cases were found on investigation. Lack of administration of immunizing doses of antitoxin resulted in many cases in the family. Non-observance of quarantine by families assisted greatly in the spread of the disease.
September through December, ...	Salem, ...	124	Contact. Quarantine not observed. Unrecognized cases. . . .	Carelessness by families in observing quarantine was apparently the cause of the increase in cases. Mild and unrecognized cases played a part also.
October and November, ...	Gloucester, ...	37	Contact. Quarantine not observed. . . .	Unrecognized cases and lack of observance of quarantine and isolation were found to be the cause of the outbreak.
October through December, ...	Westfield, ...	65	School contact, ...	Cases were in foreign population and chiefly in one school. Extensive culturing of the school children was started and is to be carried out.
October through December, ...	Everett, ...	181	School contact. Unrecognized cases.	Investigation of the situation showed that the quarantine regulations were loosely observed by parents of cases.
September through November, ...	Newton, ...	35	Contact, ...	Cases were scattered in the community. In three families there were two cases each. Two cases were nurses in the hospital.
December, ...	Hardwick, ...	9	School contact, ...	An unrecognized case existed in the school and infected other pupils. A school nurse was obtained to make daily inspection of school pupils, and the outbreak was checked.
November, ...	Belchertown, ...	6	Contact, ...	There had been no cases in the town since April, 1918, until the outbreak. Evidently the disease was brought to the village by a parent of the first case, who visited a community where diphtheria was prevalent.

Typhoid Fever.

January through March,	Lawrence,	38	Water,	Careful inquiry eliminated all causes except water, and the cases were apparently due to an unforeseen fault in the construction of the filter.
June through August,	Malden, Medford,	18	Water,	Careful investigation by the agent of the Malden board of health disclosed a polluted spring, and an analysis showed the water to be highly polluted with <i>B. coli</i> in 1.0 cubic centimeter samples.
August,	Gardner,	8	Milk (carriers),	All the cases were on a single milk route, and two typhoid bacilli carriers were found, one with typhoid bacilli in the feces, and the other in the urine.
July and August,	West Dennis,	6	Water,	Investigation of typhoid was carried out as a result of six cases of typhoid in people in Chelsea, Boston and Walpole who lived in a cottage in Dennis. A polluted well was found on the premises which apparently received the infection from a case in the house two weeks prior to the six cases.
August and September,	Tewksbury, Lowell,	14	Milk (suspected carriers),	The cases were confined to a small section of a milk route in Tewksbury and Lowell. Only one case was in Tewksbury. Two milk handlers were suspected of being typhoid bacilli carriers, but numerous fecal and urine bacteriological examinations were negative. No clinical case of typhoid or other cause was found or suspected.
September,	Attleboro,	10	Food (probable carrier),	Investigation showed the probable cause to be a waiter in a lunch room who had a positive Widal test, but repeated examinations failed to show typhoid bacilli in the feces or urine. A well and possible infection from ice were eliminated as the cause of the outbreak.
September,	Wareham,	5	Contact,	An outbreak of intestinal disease was investigated in the Onset section, and cases of typhoid were found in Waltham and Bridgewater that were infected in Wareham, and a suspicious case in Middleborough. The original source of infection was not found.
September and October,	Southbridge, Sturbridge,	13	Water,	A polluted well was located, used by all the cases, and an active case was discovered on the premises of the farm where the well was located. Many <i>B. coli</i> were present in the 1.0 cubic centimeter of the water of the well.

Typhoid Fever — Concluded.

DATE.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
September and October, . . .	Newton, Waltham, . . .	14	Unknown, . . .	The coincidences of two adjoining communities having an increase of typhoid cases at the same time led to a careful investigation of each case. No central focus of infection was located, but a typhoid bacilli carrier was found in Newton who infected one case. One case was connected with the Wareham outbreak, and three others apparently received their infection outside the State. Water from a suspected spring proved to be of good quality. No cause for the remaining cases was ascertained.
October, ...	Fitchburg, ...	2	Milk, ...	A case of typhoid had been diagnosed influenza, and milk bottles collected from the home of this case apparently infected two others. Because of a negative <i>Widal</i> nine days after the onset of initial case typhoid was ruled out. <i>Widal</i> , six weeks later, was positive.
October, ...	Worcester, ...	29	Milk, ...	Inquiry by the local board of health pointed to a typhoid bacilli carrier, and typhoid bacilli were found in his feces. He had been suspected in previous years, but no proof could be obtained. Three of the cases who were infected by the milk were reported from Dunstable, Holden and Princeton.

Diseases on Premises of Milk Handlers.

DATE.	Locality.	Disease.	Brief History of Case.
May, . . .	Mendon, . . .	Typhoid fever, .	A milk handler on a farm became sick. Precautions were taken and no cases appeared on the milk route.
May, . . .	Milford, . . .	Scarlet fever, .	A daughter of a milk producer became sick, and the sale was stopped until proper arrangements could be made. No cases occurred on the milk route.
June, . . .	Framingham, .	Smallpox, . .	The farm where the case lived was quarantined. Arrangements were made for handling the milk, and no cases appeared on the milk route.
July, . . .	Fall River, . .	Typhoid fever, .	There were three cases in the family of a milk producer. No cases on the milk route.
October, . . .	Dunstable, . .	Typhoid fever, .	A case infected in the Worcester outbreak returned to his home in Dunstable, which was a farm producing milk. No cases occurred on the milk route in Dunstable.
October, . . .	Princeton, . .	Typhoid fever, .	A case appeared on a milk farm sending milk to Worcester. There were 29 cases on the milk route in Worcester, but later the owner of the farm was proven a typhoid bacilli carrier, and the child on the farm was a victim rather than the cause of the outbreak.
November, . .	Shelburne, . .	Scarlet fever, .	First case on the milk farm was a child who contracted disease from other school children. Four cases followed on the farm. No cases occurred on the milk route.
November, . .	Sutton, . . .	Scarlet fever, .	A child on a milk farm became sick and was removed to a hospital. No cases appeared on the milk route.
December, . .	Dracut, . . .	Scarlet fever, .	A mild case existed on a milk farm two weeks before diagnosis was made. No cases occurred on the milk route as far as known.
December, . .	Belchertown, .	Diphtheria, . .	Two children on a milk farm had the disease, but no cases occurred on the milk route of the farm.
December, . .	Springfield, .	Scarlet fever, .	A son of an owner of a milk depot had the disease. No cases followed in the city that could be traceable to the milk sold by the depot.
December, . .	Spencer, . . .	Scarlet fever, .	Two cases at a milk farm. The children were isolated, and no known cases were infected by milk from the farm.
December, . .	Gardner, . . .	Scarlet fever, .	Two children on a milk farm were ill with the disease. No cases were reported in families on milk route of the farm.

CASES AND DEATHS, WITH CASE AND DEATH RATES, FOR ALL
REPORTABLE DISEASES DURING 1919.

DISEASE.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.	Fatality Rate (Per Cent).
Actinomycosis, ...	3	0	.1	—	—
Anterior poliomyelitis, ...	66	17	1.7	.4	25.8
Anthrax, ...	18	1	.5	.02	5.6
Chicken pox, ...	6,693	5	168.7	.1	.1
Diphtheria, ...	7,929	591	199.8	14.9	7.5
Dog bite (requiring anti-rabic treat- ment), ...	54	—	1.4	—	—
Dysentery, ...	23	9	.6	.2	39.1
Epidemic cerebrospinal meningitis,	253	181	6.4	4.6	71.5
German measles, ...	434	1	10.9	.02	.2
Leprosy, ...	3	1	.1	.02	33.3
Malaria, ...	72	4	1.8	.1	5.6
Measles, ...	9,985	182	251.6	4.6	1.8
Mumps, ...	3,497	10	88.1	.3	.3
Ophthalmia neonatorum, ¹ . . .	1,687	—	42.5	—	—
Pellagra, ...	13	15	.3	.4	115.4
Pneumonia (lobar), ...	4,585	2,508	115.5	63.2	54.7
Rabies, ...	1	1	.02	.02	100
Scarlet fever, ...	8,018	130	202.0	3.3	1.6
Septic sore throat, ...	216	40	5.4	1.0	18.5
Smallpox, ...	40	2	1.0	.1	5.0
Tetanus, ...	21	22	.5	.6	104.8
Trachoma, ...	72	—	1.8	—	—
Trichinosis, ...	3	—	.1	—	—
Tuberculosis (pulmonary), . . .	6,977	4,204	175.8	105.9	60.2
Tuberculosis (other forms), . . .	782	693	19.7	17.5	88.6
Typhoid fever, ...	938	103	23.6	2.6	11.0
Whooping cough, ...	5,727	319	144.3	8.0	5.6
Gonorrhea, ...	9,435	8	237.8	.2	.1
Syphilis, ...	4,127	281	104.0	7.1	6.8
Influenza, ...	40,222	3,052	1,013.5	76.9	7.6
Totals, ...	111,894	12,380	2,819.6	312.0	11.1

¹ Includes suppurative conjunctivitis.

INCIDENCE OF COMMUNICABLE DISEASES BY MONTHS, 1919.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Actinomycosis, ...	-	-	-	1	1	-	-	-	-	-	-	1	3
Anterior poliomyelitis, ...	4	2	2	4	-	3	5	12	9	17	5	3	66
Anthrax, ...	-	-	1	1	2	-	2	-	4	3	2	3	18
Chicken pox, ...	376	446	764	761	890	735	360	94	97	373	722	1,055	6,693
Diphtheria, ...	739	681	659	532	561	493	427	324	530	992	983	1,018	7,929
Dog bite (requiring anti-rabic treatment), ...	2	-	-	6	3	6	6	2	3	12	8	6	54
Dysentery, ...	2	2	-	1	-	1	3	3	6	3	2	-	23
Epidemic cerebrospinal meningitis, ...	24	23	20	31	25	25	23	15	19	14	16	18	253
German measles, ...	29	34	48	60	77	30	16	11	14	33	30	52	434
Leprosy, ...	-	-	-	-	2	-	-	-	-	-	1	-	3
Malaria, ...	-	1	-	3	3	8	20	19	5	5	4	4	72
Measles, ...	509	452	778	1,045	1,308	890	468	131	179	563	1,059	2,603	9,985
Mumps, ...	165	162	265	346	332	277	156	82	89	281	498	944	3,497
Ophthalmia neonatorum, ...	123	148	148	176	157	130	135	98	148	145	114	165	1,687
Pellagra, ...	1	1	2	-	2	3	-	3	-	1	-	-	13
Pneumonia (lobar), ...	1,096	663	588	463	352	144	109	72	142	240	275	441	4,585

INCIDENCE OF COMMUNICABLE DISEASES BY MONTHS, 1919 — *Concluded.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Rabies, ...	-	-	-	-	-	1	-	-	-	-	-	-	1
Scarlet fever, ...	563	562	719	715	810	492	268	248	407	788	1,054	1,392	8,018
Septic sore throat, ...	19	22	19	17	36	5	9	16	18	22	12	21	216
Smallpox, ...	-	-	7	6	8	11	2	-	-	2	2	2	40
Tetanus, ...	-	-	-	4	3	1	2	3	5	1	2	-	21
Trachoma, ...	4	4	3	12	6	5	5	4	6	7	8	8	72
Trichinosis, ...	-	-	2	-	-	1	-	-	-	-	-	-	3
Tuberculosis, pulmonary, ...	599	556	676	650	681	670	545	517	572	569	457	485	6,977
Tuberculosis, other forms, ...	44	67	63	69	86	76	69	50	74	62	55	67	782
Typhoid fever, ...	55	69	47	44	42	45	69	134	145	154	81	53	938
Whooping cough, ...	398	348	457	379	471	467	471	424	349	367	670	926	5,727
Gonorrhea, ...	608	640	1,010	818	812	842	1,033	730	795	785	656	706	9,435
Syphilis, ...	282	333	498	419	361	266	330	275	336	288	305	434	4,127
Influenza, ...	28,579	6,390	2,932	1,070	406	71	31	56	225	199	125	148	40,222
Total, ...	34,221	11,596	9,738	7,633	7,427	5,688	4,564	3,323	4,177	5,926	7,146	10,455	111,894

CASES AND DEATHS FROM DISEASES DANGEROUS TO THE PUBLIC HEALTH, 1919.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1919.

Abington, ...	113	Charlemont, ...	290	Gardner, ...	46
Acton, ...	197	Charlton, ...	189	Gay Head, ...	359
Acushnet, ...	163	Chatham, ...	225	Georgetown, ...	198
Adams, ...	61	Chelmsford, ...	120	Gill, ...	289
Agawam, ...	117	CHELSEA, ...	20	GLOUCESTER, ...	36
Alford, ...	355	Cheshire, ...	238	Goshen, ...	349
Amesbury, ...	90	Chester, ...	263	Gosnold, ...	362
Amherst, ...	112	Chesterfield, ...	317	Grafton, ...	101
Andover, ...	82	CHICOPPEE, ...	31	Granby, ...	296
Arlington, ...	44	Chilmark, ...	350	Granville, ...	302
Ashburnham, ...	205	Clarksburg, ...	282	Great Barrington, ...	94
Ashby, ...	291	Clinton, ...	62	Greenfield, ...	55
Ashfield, ...	283	Cohasset, ...	161	Greenwich, ...	335
Ashland, ...	192	Colrain, ...	211	Groton, ...	185
Athol, ...	69	Concord, ...	98	Groveland, ...	186
ATTLEBORO, ...	41	Conway, ...	272		
Auburn, ...	137	Cummington, ...	311	Hadley, ...	152
Avon, ...	191			Halifax, ...	306
Ayer, ...	173			Hamilton, ...	208
		Dalton, ...	136	Hampden, ...	310
Barnstable, ...	121	Dana, ...	309	Hancock, ...	320
Barre, ...	139	Danvers, ...	64	Hanover, ...	165
Becket, ...	286	Dartmouth, ...	107	Hanson, ...	226
Bedford, ...	244	Dedham, ...	65	Hardwick, ...	144
Belchertown, ...	202	Deerfield, ...	153	Harvard, ...	277
Bellingham, ...	196	Dennis, ...	227	Harwich, ...	194
Belmont, ...	73	Dighton, ...	175	Hatfield, ...	154
Berkley, ...	288	Douglas, ...	195	HAVERHILL, ...	18
Berlin, ...	300	Dover, ...	276	Hawley, ...	333
Bernardston, ...	299	Dracut, ...	129	Heath, ...	334
BEVERLY, ...	34	Dudley, ...	131	Hingham, ...	115
BillERICA, ...	145	Dunstable, ...	246	Hinsdale, ...	256
Blackstone, ...	142	Duxbury, ...	199	Holbrook, ...	158
Blandford, ...	321			Holden, ...	171
Bolton, ...	304	East Bridgewater, ...	138	Holland, ...	360
Boston, ...	3	East Longmeadow, ...	193	Holliston, ...	167
Bourne, ...	168	Eastham, ...	318	HOLYOKE, ...	17
Boxborough, ...	343	Easthampton, ...	68	Hopedale, ...	160
Boxford, ...	307	Easton, ...	125	Hopkinton, ...	184
Boylston, ...	298	Edgartown, ...	258	Hubbardston, ...	280
Braintree, ...	72	Egremont, ...	316	Hudson, ...	99
Brewster, ...	294	Enfield, ...	305	Hull, ...	187
Bridgewater, ...	70	Erving, ...	274	Huntington, ...	254
Brimfield, ...	285	Essex, ...	229		
BROCKTON, ...	16	EVERETT, ...	26	Ipewich, ...	100
Brookfield, ...	209			Kingston, ...	176
Brookline, ...	28	Fairhaven, ...	93		
Buckland, ...	237	FALL RIVER, ...	7	Lakeville, ...	223
Burlington, ...	295	Falmouth, ...	128	Lancaster, ...	177
		FITCHBURG, ...	27	Lanesborough, ...	273
CAMBRIDGE, ...	10	Florida, ...	328	LAWRENCE, ...	15
Canton, ...	104	Foxborough, ...	143	Lee, ...	127
Carlisle, ...	331	Framingham, ...	43	Leicester, ...	149
Carver, ...	228	Franklin, ...	96	Lenox, ...	150
		Freetown, ...	220		

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1919—Continued.

LEOMINSTER, ...	47	North Attleborough, ...	78	Scituate, ...	172
Leverett, ...	301	North Brookfield, ...	169	Seekonk, ...	157
Lexington, ...	110	North Reading, ...	242	Sharon, ...	181
Leyden, ...	338	NORTHAMPTON, ...	37	Sheffield, ...	213
Lincoln, ...	252	Northborough, ...	217	Shelburne, ...	246
Littleton, ...	269	Northbridge, ...	77	Sherborn, ...	210
Longmeadow, ...	218	Northfield, ...	212	Shirley, ...	190
LOWELL, ...	11	Norton, ...	179	Shrewsbury, ...	148
Ludlow, ...	91	Norwell, ...	231	Shutesbury, ...	347
Lunenburg, ...	222	Norwood, ...	59	Somerset, ...	140
LYNN, ...	12			SOMERVILLE, ...	14
Lynnfield, ...	264	Oak Bluffs, ...	255	South Hadley, ...	118
		Oakham, ...	325	Southampton, ...	284
MALDEN, ...	19	Orange, ...	116	Southborough, ...	201
Manchester, ...	155	Orleans, ...	268	Southbridge, ...	52
Mansfield, ...	106	Otis, ...	336	Southwick, ...	233
Marblehead, ...	84	Oxford, ...	146	Spencer, ...	119
Marion, ...	241			SPRINGFIELD, ...	9
MARLBOROUGH, ...	50	Palmer, ...	74	Sterling, ...	249
Marshfield, ...	230	Parton, ...	324	Stockbridge, ...	216
Mashpee, ...	356	PEABODY, ...	39	Stoneham, ...	85
Mattapoisett, ...	248	Pelham, ...	323	Stoughton, ...	89
Maynard, ...	97	Pembroke, ...	261	Stow, ...	278
Medfield, ...	141	Pepperell, ...	166	Sturbridge, ...	262
MEDFORD, ...	30	Peru, ...	361	Sudbury, ...	266
Medway, ...	164	Petersham, ...	308	Sunderland, ...	245
MELROSE, ...	45	Phillipston, ...	339	Sutton, ...	180
Mendon, ...	287	PITTSFIELD, ...	23	Swampscott, ...	83
Merrimac, ...	206	Plainfield, ...	340	Swansea, ...	159
METHUEN, ...	49	Plainville, ...	251		
Middleborough, ...	80	Plymouth, ...	58	TAUNTON, ...	29
Middlefield, ...	348	Plympton, ...	314	Templeton, ...	132
Middleton, ...	247	Prescott, ...	352	Tewksbury, ...	102
Milford, ...	56	Princeton, ...	303	Tisbury, ...	250
Millbury, ...	114	Provincetown, ...	134	Tolland, ...	358
Millville, ...	203			Topsfield, ...	275
Millis, ...	243	QUINCY, ...	22	Townsend, ...	219
Milton, ...	79			Truro, ...	312
Monroe, ...	342	Randolph, ...	124	Tyngsborough, ...	281
Monson, ...	122	Raynham, ...	215	Tyringham, ...	353
Montague, ...	81	Reading, ...	88		
Monterey, ...	344	Rehoboth, ...	188	Upton, ...	207
Montgomery, ...	357	REVERE, ...	33	Uxbridge, ...	123
Mount Washington, ...	364	Richmond, ...	326		
		Rochester, ...	271	Wakesfield, ...	57
Nahant, ...	239	Rockland, ...	95	Wales, ...	345
Nantucket, ...	151	Rockport, ...	130	Walpole, ...	111
Natick, ...	66	Rowe, ...	337	WALTHAM, ...	32
Needham, ...	86	Rowley, ...	235	Ware, ...	76
New Ashford, ...	363	Royalston, ...	293	Wareham, ...	109
NEW BEDFORD, ...	8	Russell, ...	270	Warren, ...	133
New Braintree, ...	330	Rutland, ...	204	Warwick, ...	327
New Marlborough, ...	292			Washington, ...	354
New Salem, ...	315	SALEM, ...	25	Watertown, ...	42
Newbury, ...	232	Salisbury, ...	224	Wayland, ...	214
NEWBURYPORT, ...	51	Sandisfield, ...	319	Webster, ...	60
NEWTON, ...	24	Sandwich, ...	260	Wellesley, ...	92
Norfolk, ...	240	Saugus, ...	67	Wellfleet, ...	297
NORTH ADAMS, ...	38	Savoy, ...	322	Wendell, ...	351
North Andover, ...	105				

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1919 — Concluded.

Wenham, ...	279	Westhampton, ...	332	Wilmington, ...	174
West Boylston, ...	257	Westminster, ...	221	Winchendon, ...	108
West Bridgewater, ...	156	Weston, ...	182	Winchester, ...	71
West Brookfield, ...	267	Westport, ...	147	Windsor, ...	341
West Newbury, ...	236	Westwood, ...	234	Winthrop, ...	53
West Springfield, ...	63	Weymouth, ...	54	Woburn, ...	48
West Stockbridge, ...	265	Whately, ...	259	Worcester, ...	5
West Tisbury, ...	329	Whitman, ...	87	Worthington, ...	313
Westborough, ...	103	Wilbraham, ...	178	Wrentham, ...	162
Westfield, ...	40	Williamsburg, ...	200	Yarmouth, ...	253
Westford, ...	170	Williamstown, ...	135		

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Pox.		Ep. Cere- bro- spinal Menin- gitis.		Diph- theria.		Ger- man Mea- sles.		Lobar Pneu- monia.		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
1	Massachusetts, ...	3,991,969	6693	5	253	181	7929	591	434	1	4585	2508	9985	182
2	CITIES OVER 500,000.													
3	Boston, ...	808,442	1753	-	71	55	2333	153	65	-	1597	591	2200	27
4	CITIES OVER 150,000.													
5	Worcester, ...	176,761	186	1	7	9	362	18	12	-	183	171	748	24
6	CITIES, 100,000-150,000.	687,463	1098	-	38	29	1397	131	101	-	804	397	2849	88
7	Fall River, ...	129,416	173	-	10	7	220	24	13	-	144	59	1209	58
8	New Bedford, ...	120,438	83	-	3	7	143	22	21	-	59	44	746	15
9	Springfield, ...	114,792	302	-	3	3	140	25	24	-	251	90	40	2
10	Cambridge, ...	112,176	366	-	5	2	253	5	22	-	153	72	266	2
11	Lowell, ...	109,396	53	-	9	7	268	25	3	-	101	67	171	7
12	Lynn, ...	101,245	115	-	8	3	373	30	18	-	96	65	417	6
13	CITIES, 50,000-100,000.	478,428	673	3	38	24	798	77	48	-	568	303	791	8
14	Somerville, ...	94,950	138	-	4	4	205	11	6	-	109	58	98	1
15	Lawrence, ...	93,933	85	1	9	5	131	19	4	-	80	57	24	-
16	Brockton, ...	66,824	133	-	3	2	114	8	8	-	31	25	474	1
17	Holyoke, ...	63,413	31	-	2	2	55	11	10	-	33	41	87	3
18	Haverhill, ...	53,940	167	-	4	2	151	14	9	-	196	43	50	3
19	Malden, ...	52,699	56	1	6	4	75	9	6	-	45	36	29	-
20	Chelsea, ...	52,663	73	-	4	4	67	5	3	-	74	42	29	1
21	CITIES AND TOWNS, 25,000-50,000.	506,608	996	-	24	13	1110	87	30	-	407	380	653	16
22	Quincy, ...	47,433	77	-	4	2	100	5	3	-	30	30	20	-
23	Pittsfield, ...	45,907	100	-	4	1	13	2	2	-	40	30	4	-
24	Newton, ...	45,895	196	-	2	1	87	9	8	-	26	21	29	-
25	Salem, ...	42,292	108	-	3	2	226	18	-	-	53	24	37	-
26	Everett, ...	41,282	102	-	5	3	249	19	-	-	50	21	36	1
27	Fitchburg, ...	41,196	32	-	2	-	52	10	1	-	53	28	26	-
28	Brookline, ...	38,287	230	-	1	1	41	1	5	-	48	19	127	-
29	Taunton, ...	37,761	12	-	-	-	38	1	4	-	21	49	250	13
30	Medford, ...	36,702	28	-	1	-	55	3	4	-	23	28	31	1
31	Chicopee, ...	34,124	8	-	-	1	67	8	1	-	11	19	42	-
32	Waltham, ...	32,107	71	-	1	2	60	4	-	-	19	18	34	-
33	Revere, ...	31,035	-	-	-	-	108	4	-	-	4	11	-	-
34	Beverly, ...	26,587	32	-	1	-	14	3	2	-	29	12	17	-
35	CITIES AND TOWNS, 10,000-25,000.	597,915	1166	-	38	22	1051	67	91	-	518	305	1146	9
36	Gloucester, ...	24,545	13	-	1	-	49	1	-	-	17	7	5	-
37	Northampton, ...	23,526	25	-	-	1	36	4	2	-	22	12	12	-
38	North Adams, ...	22,048	33	-	1	1	6	2	-	-	15	13	2	1
39	Peabody, ...	21,070	17	-	1	-	26	3	-	-	10	10	20	-
40	Westfield, ...	20,402	31	-	1	1	139	13	-	-	41	9	4	-
41	Attleboro, ...	20,386	27	-	1	1	59	1	1	-	11	10	14	-
42	Watertown, ...	19,579	44	-	2	1	29	-	4	-	29	6	41	-
43	Framingham, ...	18,310	88	-	3	1	12	1	2	-	11	11	35	-

to the Public Health, 1919.

33A		7		28-29		30-35		1		3		100		19C		33C		37		10		Line No.	
Ophthal- mia Neona- torum.		Scarlet Fever.		Tuber- culosis, Pulmo- nary.		Tuber- culosis, Other Forms.		Ty- phoid Fever.		Whoop- ing Cough.		Septic Sore Throat.		Mumps		Gonor- rhea.		Syph- ilis.		Influ- enza.			
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.		
1687	-	8018	130	6977	4204	782	693	938	103	5727	319	216	40	3497	10	9435	8	4127	281	40222	3052	1	
559	-	1881	39	2184	965	235	182	106	16	1011	60	60	7	1009	-	3992	-	1774	97	8453	903	2	
126	-	281	5	314	187	19	39	43	5	199	31	1	-	67	-	458	-	307	26	1358	134	3	
544	-	1848	28	1417	754	189	155	188	26	988	59	38	7	417	3	1653	8	581	37	6419	507	4	
164	-	63	4	281	142	34	27	70	4	167	11	5	1	33	1	244	-	77	12	1299	101	5	
178	-	158	4	406	139	47	39	17	3	84	19	2	-	25	-	236	-	125	6	964	91	6	
50	-	176	3	155	98	30	20	24	5	155	2	1	2	23	-	402	-	172	5	777	102	7	
52	-	190	-	212	176	22	17	14	2	432	12	10	2	267	1	200	-	78	4	1371	54	8	
75	-	325	6	226	110	42	41	32	5	32	4	11	1	51	1	272	-	65	4	1020	75	9	
25	-	436	11	137	89	14	11	31	7	112	11	3	1	18	-	199	2	64	6	988	84	10	
287	-	946	18	758	487	108	81	156	19	558	35	89	3	267	8	908	8	370	18	5885	345	11	
26	-	208	2	139	82	25	13	14	1	74	4	11	-	36	1	103	-	28	2	1437	71	12	
16	-	195	7	146	138	22	21	77	8	47	7	-	-	46	-	134	-	99	1	540	81	13	
56	-	117	-	106	46	19	15	6	1	52	-	5	1	7	-	129	-	53	4	461	32	14	
12	-	206	5	79	65	1	9	3	1	12	13	1	1	14	-	54	-	30	3	65	21	15	
36	-	36	-	127	55	16	6	21	3	312	7	8	-	12	-	360	-	116	-	1446	47	16	
14	-	119	4	81	38	9	8	27	2	35	4	1	1	90	-	51	1	7	-	701	45	17	
61	-	65	-	74	43	16	9	8	3	26	3	3	-	62	1	77	-	27	2	635	48	18	
83	-	1038	18	728	410	71	67	122	11	785	51	24	4	459	1	606	8	309	34	4811	291	19	
3	-	141	-	78	37	5	6	12	1	37	6	1	-	19	-	66	-	15	1	671	25	20	
6	-	47	1	79	42	9	8	13	-	223	8	-	1	119	-	65	-	16	-	46	23	21	
7	-	107	-	51	19	13	7	18	2	79	-	4	-	27	1	35	1	6	1	684	27	22	
9	-	233	6	61	54	6	3	3	-	177	15	-	1	15	-	51	-	17	8	228	18	23	
9	-	81	-	64	19	7	3	19	3	47	4	1	1	74	-	39	-	17	-	567	12	24	
3	-	26	-	66	41	9	7	5	-	2	1	-	-	3	-	64	1	34	-	314	22	25	
7	-	62	-	57	18	1	7	7	-	74	-	4	-	140	-	22	-	11	1	523	16	26	
11	-	35	1	79	64	6	9	4	1	32	5	1	-	3	-	120	-	44	26	314	36	27	
8	-	44	-	30	29	8	7	15	-	39	7	8	-	21	-	29	-	9	-	506	32	28	
12	-	70	2	66	44	1	3	3	-	2	2	-	-	-	-	26	-	6	-	59	16	29	
2	-	96	-	27	11	-	1	8	1	-	1	-	-	-	-	31	-	9	2	395	32	30	
6	-	43	-	27	11	3	1	4	1	51	1	-	-	35	-	47	-	16	-	157	22	31	
199	-	1548	26	809	503	70	77	178	11	1100	44	45	13	589	8	873	8	309	38	5989	371	32	
5	-	226	9	54	21	3	3	9	-	47	3	-	-	5	-	33	-	14	2	166	16	33	
3	-	52	3	26	41	1	7	10	-	13	-	-	-	20	-	33	-	2	18	182	30	34	
3	-	11	-	35	16	7	3	6	1	41	2	-	-	14	-	38	-	2	-	58	4	35	
3	-	27	-	45	18	-	-	1	3	-	29	4	1	-	1	27	-	4	2	101	13	36	
3	-	99	-	25	87	-	2	3	-	8	1	-	-	5	-	35	-	11	-	66	12	37	
1	-	46	1	23	14	1	1	15	2	36	2	-	-	2	-	27	-	20	-	455	20	38	
2	-	23	-	22	8	7	4	3	-	29	-	-	1	-	-	25	-	5	-	261	13	39	
1	-	50	-	36	12	1	3	4	-	27	-	-	1	2	14	-	212	-	18	-	79	11	40

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Pox.		Ep. Cere- bro- spinal Menin- gitis.		Diph- theria.		Ger- man Mea- sles.		Lobar Pneu- monia.		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
44	Arlington, ...	18,004	21	-	3	1	30	-	-	-	7	9	6	-
45	Melrose, ...	17,860	17	-	-	-	13	-	4	-	12	4	10	-
46	Gardner, ...	17,786	74	-	2	2	14	1	6	-	16	17	3	-
47	Leominster, ...	17,701	76	-	3	4	9	1	4	-	35	22	435	3
48	Woburn, ...	17,336	13	-	1	-	17	3	1	-	16	14	2	-
49	Methuen, ...	16,161	16	-	1	-	24	2	1	-	18	10	2	-
50	Marlborough, ...	15,814	78	-	-	-	21	1	10	-	4	3	16	-
51	Newburyport, ...	15,614	83	-	3	1	17	3	17	-	25	10	17	-
52	Southbridge, ...	15,580	5	-	1	-	8	-	1	-	4	6	19	-
53	Winthrop, ...	14,968	100	-	2	1	14	1	12	-	20	9	10	-
54	Weymouth, ...	14,874	1	-	2	1	33	1	-	-	22	10	4	-
55	Greenfield, ...	14,466	13	-	1	-	59	1	9	-	12	7	14	-
56	Milford, ...	14,214	15	-	1	-	39	-	1	-	7	12	5	-
57	Wakefield, ...	13,939	12	-	1	1	18	-	-	-	19	8	1	-
58	Plymouth, ...	13,587	14	-	-	-	14	1	-	-	1	7	15	-
59	Norwood, ...	13,472	27	-	-	-	15	-	4	-	15	8	5	1
60	Webster, ...	13,453	21	-	1	1	26	4	-	-	11	2	40	-
61	Adams, ...	13,378	5	-	-	-	28	2	-	-	8	6	1	-
62	Clinton, ...	13,289	10	1	1	2	12	3	1	-	22	9	4	1
63	West Springfield, ...	13,119	12	-	-	-	15	2	-	-	5	4	-	-
64	Danvers, ...	12,663	45	-	-	-	40	-	-	-	6	11	141	-
65	Dedham, ...	12,324	16	-	1	-	47	1	-	-	5	2	151	1
66	Natick, ...	12,175	42	-	-	-	8	-	-	-	11	5	5	-
67	Saugus, ...	12,061	21	-	-	-	52	2	2	-	5	4	53	1
68	Easthampton, ...	10,956	11	-	-	-	23	2	-	-	9	1	1	-
69	Athol, ...	10,831	5	-	-	-	14	2	-	-	7	5	21	1
70	Bridgewater, ...	10,807	10	-	-	-	35	-	4	-	2	3	20	-
71	Winchester, ...	10,590	48	-	-	-	5	-	1	-	11	4	-	-
72	Braintree, ...	10,417	14	1	4	1	12	1	2	-	9	5	5	-
73	Belmont, ...	10,219	58	-	1	-	7	-	2	-	13	6	7	-
74	Palmer, ...	10,191	4	-	-	-	26	8	-	-	6	-	-	-
75	Towns, 5,000-10,000.	342,000	499	-	17	11	433	23	50	1	255	190	632	1
76	Ware, ...	9,808	6	-	1	1	3	-	-	-	2	4	-	-
77	Northbridge, ...	9,629	4	-	-	-	4	1	-	-	2	5	21	-
78	North Attleborough, ...	9,536	8	-	-	-	29	-	1	-	17	5	5	-
79	Milton, ...	9,168	55	-	-	-	3	-	1	-	2	3	48	-
80	Middleborough, ...	8,981	7	-	-	-	8	-	-	-	7	7	19	-
81	Montague, ...	8,814	4	-	1	10	1	4	-	-	3	4	1	-
82	Andover, ...	8,547	21	-	-	-	24	2	-	-	9	5	-	-
83	Swampscott, ...	8,305	5	-	-	-	6	-	1	-	5	4	48	-
84	Marblehead, ...	7,933	1	-	1	-	2	-	-	-	1	2	3	-
85	Stoneham, ...	7,825	7	-	-	-	14	1	-	-	11	7	1	-
86	Needham, ...	7,817	19	-	-	-	5	-	-	-	10	3	1	-
87	Whitman, ...	7,713	18	-	1	1	7	-	8	-	12	2	11	-
88	Reading, ...	7,635	1	-	-	-	3	-	-	-	2	2	-	-
89	Stoughton, ...	7,542	2	-	-	-	12	-	-	-	10	2	-	-
90	Amesbury, ...	7,407	-	-	1	1	7	1	1	-	16	10	-	-
91	Ludlow, ...	7,349	20	-	1	3	2	-	-	-	7	3	1	-
92	Wellesley, ...	7,302	55	-	-	-	24	-	12	-	14	3	4	-
93	Fairhaven, ...	7,249	2	-	-	-	10	2	1	-	1	3	50	-
94	Great Barrington, ...	7,216	4	-	-	-	-	-	1	-	6	7	6	-
95	Rockland, ...	7,196	4	-	2	2	9	-	5	-	2	1	32	-
96	Franklin, ...	7,113	12	-	-	-	1	-	-	-	8	2	112	-
97	Maynard, ...	7,090	-	-	1	1	4	1	-	-	1	1	-	-
98	Concord, ...	6,900	36	-	-	-	35	-	3	-	6	14	3	-
99	Hudson, ...	6,771	4	-	5	2	4	-	-	-	1	7	-	-
100	Ipswich, ...	6,689	5	-	1	-	10	-	-	-	1	1	2	-
101	Grafton, ...	6,688	-	-	-	-	4	-	-	-	6	7	8	-
102	Tewksbury, ...	6,540	-	-	-	-	1	-	-	-	1	1	-	-
103	Westborough, ...	6,329	11	-	-	-	2	-	-	-	7	11	7	-

to the Public Health, 1919 — Continued.

33A		7		28-29		30-35		1		8		100		19C		38C		37		10		Line No.
Ophthal- mia Neona- torum.		Scarlet Fever.		Tuber- culosis, Pulmo- nary.		Tuber- culosis, Other Forms.		Ty- phoid Fever.		Whoop- ing Cough.		Septic Sore Throat.		Mumps		Gonor- rhea.		Syph- ilis.		Influ- enza.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1	17	40	-	26	10	2	2	6	-	45	4	5	-	39	1	10	-	4	1	243	7	44
2	2	47	1	12	8	1	1	1	2	64	-	1	-	4	-	18	-	7	-	307	13	45
5	5	13	1	51	20	1	2	13	2	7	-	-	-	58	-	21	-	4	1	136	9	46
1	1	56	-	39	19	3	3	8	3	91	3	1	-	9	-	36	-	2	-	368	10	47
3	3	11	-	25	14	2	1	1	8	58	2	1	-	34	-	23	-	-	-	180	16	48
1	1	26	-	22	14	2	1	2	2	12	-	-	-	21	-	9	-	1	-	115	7	49
2	2	7	-	32	10	-	1	1	7	37	-	-	-	5	-	8	-	-	-	118	12	50
4	4	5	2	11	8	2	4	12	1	30	3	29	8	4	1	19	-	2	1	112	3	51
9	9	4	-	15	5	1	1	12	1	8	-	-	-	8	-	32	-	3	1	58	5	52
1	1	55	1	18	7	2	2	2	2	36	-	-	-	59	-	15	-	8	-	155	7	53
9	9	25	-	17	10	2	2	2	2	4	1	-	-	-	-	12	-	8	-	111	7	54
1	1	24	-	12	6	4	2	3	3	105	3	-	-	30	-	12	-	9	1	153	11	55
1	1	69	1	16	21	7	6	3	-	2	-	1	-	33	-	13	-	3	1	89	14	56
2	2	46	2	13	8	1	4	-	-	16	1	-	-	10	-	3	-	-	-	63	7	57
3	3	6	-	14	9	1	1	3	-	-	-	-	-	11	-	10	-	4	1	57	7	58
8	8	39	-	10	19	-	3	1	1	7	-	-	-	-	-	13	-	6	-	149	72	59
5	5	2	-	12	13	3	3	3	3	4	-	-	-	1	-	17	-	6	-	71	5	60
2	2	24	-	18	15	4	4	2	-	10	3	-	-	-	-	22	-	5	-	203	15	62
2	2	26	-	7	5	-	-	-	-	-	-	-	-	1	-	17	-	9	-	12	7	63
2	2	22	-	15	22	3	4	-	-	60	5	-	-	5	-	17	-	43	1	105	3	64
2	2	15	-	9	3	-	-	1	1	54	-	-	-	8	-	14	-	16	-	39	1	65
2	2	11	-	15	3	1	1	6	-	-	-	3	1	7	-	17	-	7	-	301	10	66
2	2	47	-	11	3	-	1	3	-	22	2	1	-	4	-	6	-	5	1	527	9	67
-	-	54	3	13	3	-	-	-	-	2	2	-	-	-	-	4	-	1	-	45	3	68
-	-	8	-	5	8	-	-	2	-	1	1	-	-	2	-	17	-	2	-	194	7	69
1	1	53	-	25	21	4	1	3	-	7	-	-	-	2	-	14	-	10	-	67	4	70
5	5	13	-	10	5	2	-	1	1	15	1	-	-	10	-	10	-	1	-	252	16	71
-	-	22	-	14	18	1	2	2	-	39	-	-	-	1	-	14	-	2	-	171	7	72
-	-	24	-	18	8	1	-	2	-	115	1	-	-	96	-	8	-	4	-	169	3	73
-	-	13	-	3	4	-	3	-	-	-	-	-	-	3	-	5	-	7	-	12	11	74
29	-	545	4	347	230	46	39	67	5	430	19	8	-	256	2	366	-	116	13	3370	228	75
-	-	9	-	2	7	-	2	-	-	-	-	-	-	11	-	9	-	4	-	6	2	76
2	2	6	-	20	9	-	1	2	-	13	2	-	-	1	-	13	-	2	-	5	10	77
1	1	3	-	9	6	2	3	2	-	18	4	-	-	1	-	30	-	5	-	256	10	78
1	1	12	-	10	4	1	-	2	1	2	-	-	-	4	-	4	-	2	-	152	4	79
3	3	5	-	17	7	-	1	2	-	23	1	-	-	5	-	10	-	-	-	7	2	80
1	1	31	-	10	8	-	-	3	-	-	-	-	-	3	-	1	-	-	-	20	2	81
1	1	9	-	3	2	1	1	1	-	5	-	-	-	29	-	8	-	1	-	117	7	82
2	2	21	-	2	2	1	1	3	-	13	-	-	-	2	-	4	-	4	-	30	3	83
-	-	26	-	6	8	-	-	1	1	-	-	-	-	-	-	14	-	3	-	16	2	84
-	-	4	-	8	4	-	-	1	1	24	1	-	-	1	-	9	-	4	-	131	9	85
-	-	9	-	8	3	2	1	1	-	2	-	-	-	4	-	5	-	2	-	99	7	86
-	-	20	-	9	2	-	-	-	-	2	-	-	-	3	-	9	-	-	-	41	9	87
-	-	5	-	3	4	-	-	1	-	-	-	-	-	-	-	6	-	-	-	12	2	88
1	1	7	-	1	7	-	1	2	-	-	-	-	-	-	-	3	-	2	-	2	4	89
2	2	2	-	12	10	-	1	1	-	24	1	-	-	1	-	36	-	3	-	132	9	90
4	4	4	-	6	1	2	3	-	-	28	1	-	-	63	-	2	-	-	-	73	2	91
1	1	11	-	7	2	-	1	4	1	8	-	1	-	29	-	8	-	2	-	120	4	92
-	-	-	-	12	3	-	2	-	-	3	1	-	-	-	-	1	-	-	-	39	4	93
-	-	10	-	8	1	3	2	2	1	27	-	-	-	1	-	12	-	3	-	-	3	94
-	-	22	-	5	7	1	1	1	-	4	-	-	-	-	-	3	-	1	-	69	3	95
-	-	15	-	2	3	2	-	-	-	-	-	-	-	-	-	16	-	3	1	14	4	96
-	-	-	-	4	3	-	-	-	-	-	-	-	-	-	-	5	-	-	-	39	10	97
1	1	17	-	10	2	-	-	1	-	65	-	-	-	1	-	26	-	8	-	369	11	98
1	1	2	-	14	4	3	1	2	-	28	-	-	-	-	-	9	-	1	-	2	6	99
1	1	37	-	8	4	1	1	-	-	5	-	-	-	1	2	3	-	1	-	6	4	100
-	-	16	-	33	29	-	-	1	-	6	-	-	-	1	-	2	-	-	-	43	6	101
-	-	3	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102
-	-	8	-	11	10	-	1	1	1	11	-	-	-	9	-	11	-	32	9	100	3	103

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Fox.		Ep. Cere- bro- spinal Mening- itis.		Diph- theria.		Ger- man Mea- sles.		Lobar Pneu- monia-		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
104	Canton, ...	6,318	15	-	-	-	4	-	6	1	-	-	4	1
105	North Andover, ...	6,314	-	-	1	-	2	1	-	-	5	4	-	-
106	Mansfield, ...	6,268	17	-	-	-	1	-	1	-	5	2	8	-
107	Dartmouth, ...	6,130	3	-	-	-	1	-	-	-	7	-	17	-
108	Winchendon, ...	6,102	1	-	-	-	2	-	-	-	2	1	48	-
109	Wareham, ...	6,081	8	-	-	-	4	-	-	-	2	2	51	-
110	Lexington, ...	6,060	8	-	-	-	9	-	-	-	10	1	3	-
111	Walpole, ...	5,995	23	-	-	-	7	-	-	-	10	1	-	-
112	Amherst, ...	5,933	89	-	-	-	4	-	1	-	8	-	6	-
113	Abington, ...	5,806	3	-	-	-	13	-	-	-	-	3	49	-
114	Millbury, ...	5,762	4	-	-	-	3	1	-	-	1	-	5	-
115	Hingham, ...	5,516	4	-	1	-	1	-	-	-	6	-	-	-
116	Orange, ...	5,459	-	-	1	-	28	2	-	-	-	2	-	-
117	Agawam, ...	5,443	-	-	-	-	11	-	-	-	1	4	-	-
118	South Hadley, ...	5,419	1	-	-	-	9	-	-	-	1	-	-	-
119	Spencer, ...	5,367	1	-	-	-	50	4	-	-	-	5	-	-
120	Chelmsford, ...	5,326	-	-	1	1	-	-	-	-	1	5	5	-
121	Barnstable, ...	5,264	5	-	-	-	8	-	3	-	6	3	6	-
122	Monson, ...	5,210	-	-	-	-	4	-	-	-	1	5	12	1
123	Uxbridge, ...	5,131	1	-	-	-	8	2	-	-	7	-	-	-
124	Randolph, ...	5,100	-	-	-	-	3	-	-	-	-	5	-	-
125	Easton, ...	5,001	5	-	-	-	15	-	1	-	2	1	31	-
126	TOWNS, 2,500-5,000.	188,565	159	-	8	6	250	16	14	-	93	92	395	6
127	Lee, ...	4,783	2	-	-	-	5	2	-	-	-	-	-	-
128	Falmouth, ...	4,569	2	-	1	-	15	-	-	-	-	-	1	-
129	Dracut, ...	4,494	-	-	-	-	-	-	-	-	-	1	3	-
130	Rockport, ...	4,474	2	-	-	-	5	-	-	-	2	1	17	-
131	Dudley, ...	4,462	1	-	-	-	10	1	-	-	5	4	-	-
132	Templeton, ...	4,355	4	-	-	-	5	1	-	-	15	-	44	-
133	Warren, ...	4,335	-	-	1	-	6	-	-	-	-	4	4	-
134	Provincetown, ...	4,232	4	-	2	1	-	-	1	-	1	1	-	-
135	Williamstown, ...	4,212	-	-	-	-	-	-	-	-	-	10	-	-
136	Dalton, ...	4,102	-	-	-	-	-	-	-	-	-	1	-	-
137	Auburn, ...	4,005	-	-	-	-	-	-	-	-	-	-	22	1
138	East Bridgewater, ...	3,963	-	-	-	-	2	1	-	-	8	2	-	-
139	Barre, ...	3,913	2	-	-	-	4	-	-	-	1	2	3	-
140	Somerset, ...	3,865	-	-	-	-	5	-	-	-	5	2	31	-
141	Medfield, ...	3,800	3	-	-	-	2	-	-	-	-	4	2	-
142	Blackstone, ...	3,700	-	-	-	-	-	-	-	-	-	4	-	-
143	Foxborough, ...	3,663	1	-	-	-	23	2	1	-	2	-	9	-
144	Hardwick, ...	3,655	-	-	-	-	14	1	-	-	-	-	-	-
145	Billerica, ...	3,629	4	-	1	1	21	-	-	-	1	1	6	-
146	Oxford, ...	3,573	-	-	-	-	2	-	-	-	-	1	17	-
147	Westport, ...	3,543	3	-	-	-	5	1	2	-	-	-	66	1
148	Shrewsbury, ...	3,509	1	-	-	-	1	-	-	-	5	2	-	-
149	Leicester, ...	3,384	-	-	-	-	-	-	-	-	-	2	2	-
150	Nantuxet, ...	3,384	6	-	-	-	1	-	2	-	1	3	11	-
151	Nantuxet, ...	3,338	1	-	-	-	2	-	-	-	4	2	-	-
152	Hadley, ...	3,226	1	-	-	-	9	-	1	-	-	2	-	-
153	Deerfield, ...	3,185	-	-	-	-	2	-	-	-	-	-	-	-
154	Hatfield, ...	3,173	-	-	1	-	1	-	-	-	1	2	1	-
155	Manchester, ...	3,173	8	-	-	-	-	-	-	-	-	2	-	-
156	West Bridgewater, ...	3,170	-	-	-	-	-	-	-	-	-	-	-	-
157	Seekonk, ...	3,079	-	-	-	-	3	-	-	-	-	2	1	-
158	Holbrook, ...	3,068	-	-	1	-	-	-	-	-	-	-	-	-
159	Swansea, ...	3,048	-	-	-	-	1	1	-	-	6	2	6	1
160	Hopedale, ...	3,045	1	-	-	-	6	-	-	-	1	1	-	-
161	Cohasset, ...	2,981	3	-	1	-	1	-	-	-	1	1	1	-
162	Wrentham, ...	2,978	29	-	1	1	4	-	-	-	10	1	1	-
163	Acushnet, ...	2,972	-	-	-	-	7	2	-	-	-	1	2	-

to the Public Health, 1919—Continued.

32A		7		22-29		30-35		1		8		100		19C		33C		37		10		Line No.
Ophthal- mia Neona- torum.		Scarlet Fever.		Tuber- culosis, Pulmo- nary.		Tuber- culosis, Other Forms.		Ty- phoid Fever.		Whoop- ing Cough.		Septic Sore Throat.		Mumps		Gonor- rhea.		Syph- ilis.		Influ- enza.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
-	-	5	1	9	2	23	3	2	-	2	-	-	-	15	-	1	-	1	-	4	3	104
-	-	19	-	6	3	22	2	2	-	-	-	-	-	4	-	3	-	-	-	44	1	105
-	-	41	-	7	2	1	1	-	-	23	-	-	-	1	-	20	-	5	-	105	4	106
4	-	8	1	7	8	-	-	1	-	2	2	3	-	4	-	2	-	-	-	81	10	107
-	-	9	-	9	4	-	-	2	-	9	-	-	-	8	-	3	-	3	-	273	15	108
2	-	7	-	6	5	-	-	1	-	6	-	1	-	-	-	3	-	1	-	40	1	109
-	-	3	-	6	3	-	-	1	-	31	1	-	-	7	-	4	-	1	-	151	5	110
-	-	13	-	6	-	-	-	5	-	24	-	3	-	24	-	7	-	1	-	176	2	111
2	-	6	-	4	1	1	-	3	-	2	-	-	-	1	-	3	-	2	-	158	1	112
-	-	25	-	4	1	2	-	1	-	2	-	-	-	1	-	7	-	1	-	-	3	113
-	-	11	-	3	3	-	-	1	-	-	-	-	-	11	-	8	-	5	-	1	5	114
-	-	4	-	5	1	-	-	-	-	8	1	-	-	1	-	5	-	5	-	109	5	115
-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	116
-	-	2	-	3	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	2	117
-	-	32	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	17	1	118
-	-	9	-	2	5	-	-	1	-	1	-	-	-	-	-	5	-	4	-	-	-	119
-	-	7	-	1	6	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	4	120
-	-	12	-	8	2	-	-	-	-	5	-	-	-	7	-	18	-	2	-	145	6	121
-	-	6	-	15	10	-	-	1	-	-	-	-	-	-	-	2	-	7	-	8	1	122
-	-	6	-	3	5	-	-	2	-	-	1	-	-	3	-	3	-	1	-	68	4	123
-	-	1	-	2	6	-	-	1	-	8	-	-	-	-	-	-	-	-	-	5	5	124
-	-	4	-	2	1	-	-	1	-	1	-	1	-	-	-	3	-	-	-	84	2	125
8	-	357	2	188	148	17	20	33	3	228	11	5	-	171	-	179	-	133	6	2412	119	126
-	-	10	-	2	1	2	-	-	-	4	-	-	-	-	-	3	-	2	-	92	2	127
-	-	8	-	1	3	2	-	-	-	18	-	-	-	5	-	4	-	2	-	7	-	128
-	-	5	-	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	129
-	-	14	-	5	1	2	1	5	-	23	-	-	-	1	-	2	-	1	-	73	2	130
1	-	-	-	3	2	-	1	5	2	6	1	-	-	35	-	2	-	1	1	5	1	131
1	-	22	-	2	1	-	1	1	-	6	1	-	-	4	-	5	-	440	15	132	-	132
1	-	3	-	5	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	2	133
1	-	3	-	2	6	-	1	1	-	2	-	1	-	-	-	8	-	1	-	28	2	134
1	-	1	-	3	3	-	-	-	-	-	-	-	-	1	-	3	-	-	-	-	2	135
1	-	5	1	3	2	-	-	2	-	2	-	-	-	1	-	-	-	-	-	31	6	136
8	-	1	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	137
4	-	43	10	-	-	-	-	-	-	-	-	-	-	1	-	2	-	1	-	34	1	138
2	-	6	-	1	3	-	-	-	-	-	-	-	-	25	-	1	-	3	-	112	2	139
4	-	1	-	3	1	3	-	-	-	-	1	-	-	12	-	-	-	-	-	21	1	140
3	-	12	22	2	2	1	-	1	-	-	-	-	-	-	-	1	-	1	-	3	4	141
1	-	47	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	142
6	-	9	7	-	-	-	-	-	-	-	-	-	-	-	-	13	-	10	-	54	1	143
8	-	4	2	1	1	1	-	-	-	-	-	-	-	-	-	7	-	3	1	134	3	144
1	-	1	1	2	2	-	-	-	-	8	1	-	-	-	-	2	-	2	-	7	7	145
6	-	4	-	1	-	-	-	-	-	5	1	-	-	-	-	1	-	1	-	56	9	146
2	-	4	-	3	1	-	-	1	-	9	-	-	-	-	-	2	-	1	-	216	5	147
4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	23	4	148
2	-	5	3	3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	4	-	149
2	-	2	2	2	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	7	2	150
16	-	1	2	3	4	-	-	1	1	-	1	-	-	-	-	1	-	-	-	82	2	151
1	-	1	2	2	2	-	-	-	-	5	-	-	-	-	-	1	-	2	1	52	-	152
12	-	1	-	1	-	-	-	1	-	13	-	-	-	-	-	9	-	-	-	139	3	153
4	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	154
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	155
2	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	156
-	-	3	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	157
-	-	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	158
-	-	1	-	7	1	-	-	2	-	8	-	-	-	6	-	2	-	-	-	44	2	159
-	-	5	-	2	1	-	-	-	-	-	-	-	-	20	-	7	-	-	-	42	1	160
3	-	6	-	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	22	-	161
-	-	3	-	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	162

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Pox.		Ep. Cere- bro- spinal Menin- gitis.		Diph- theria.		Ger- man Mea- sles.		Lobar Pneu- monia.		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
164	Medway, ...	2,972	-	-	-	-	4	-	-	-	-	-	3	-
165	Hanover, ...	2,952	6	-	-	-	-	-	1	-	-	-	2	3
166	Pepperell, ...	2,935	-	-	-	-	-	-	-	-	-	-	2	-
167	Holliston, ...	2,852	-	-	-	-	1	-	-	-	-	-	2	-
168	Bourne, ...	2,840	2	-	-	-	1	-	-	-	2	6	23	1
169	North Brookfield, ...	2,838	-	-	-	-	-	-	-	-	-	1	1	1
170	Westford, ...	2,835	18	-	-	-	5	1	3	-	-	1	1	7
171	Holden, ...	2,822	9	-	-	-	-	-	1	-	1	1	14	5
172	Scituate, ...	2,813	-	-	-	-	-	-	-	-	1	1	1	1
173	Ayer, ...	2,763	10	-	-	-	27	1	1	-	7	1	10	1
174	Wilmington, ...	2,726	-	-	-	-	-	-	-	-	-	1	1	-
175	Dighton, ...	2,722	-	-	-	-	1	-	-	-	-	-	-	-
176	Kingston, ...	2,694	-	-	-	-	-	1	-	-	-	2	-	-
177	Lancaster, ...	2,686	2	-	1	-	8	-	-	-	3	1	16	-
178	Wilbraham, ...	2,681	-	-	1	-	-	-	-	-	-	-	-	2
179	Norton, ...	2,625	-	-	-	-	-	-	-	-	-	-	-	32
180	Sutton, ...	2,619	2	-	-	-	3	1	-	-	-	-	4	1
181	Sharon, ...	2,602	4	-	-	-	5	-	1	-	-	-	-	-
182	Weston, ...	2,540	8	-	-	-	7	-	-	-	9	-	30	-
183	TOWNS UNDER 2,500.	211,793	150	-	12	9	176	17	14	-	104	116	563	4
184	Hopkinton, ...	2,495	-	-	-	-	-	-	-	-	-	2	2	-
185	Groton, ...	2,484	4	-	-	-	-	-	-	-	-	2	5	-
186	Groveland, ...	2,482	1	-	-	-	1	-	-	-	3	2	1	-
187	Hull, ...	2,446	5	-	1	-	5	-	-	-	4	1	2	-
188	Rehoboth, ...	2,418	-	-	-	-	1	1	-	-	-	3	4	19
189	Charlton, ...	2,365	-	-	-	-	-	-	-	-	-	4	21	17
190	Shirley, ...	2,344	11	-	-	-	17	-	-	-	7	1	17	16
191	Avon, ...	2,290	4	-	1	1	2	-	-	-	1	-	-	-
192	Ashland, ...	2,278	5	-	-	-	-	-	-	-	1	1	2	-
193	East Longmeadow, ...	2,263	-	-	-	-	1	-	-	-	-	2	-	-
194	Harwich, ...	2,233	2	-	-	-	-	-	-	-	-	-	4	-
195	Douglas, ...	2,201	5	-	-	-	-	-	-	-	6	1	4	-
196	Bellingham, ...	2,168	-	-	-	-	-	-	-	-	-	-	-	-
197	Acton, ...	2,164	10	-	-	-	2	-	-	-	-	3	-	-
198	Georgetown, ...	2,142	-	-	-	-	4	1	-	-	2	-	1	-
199	Duxbury, ...	2,118	-	-	-	-	2	-	1	-	-	1	-	-
200	Williamsburg, ...	2,106	3	-	-	-	1	-	-	-	-	2	1	-
201	Southborough, ...	2,028	-	-	-	-	5	1	-	-	-	1	1	-
202	Belchertown, ...	2,070	6	-	-	-	8	1	-	-	-	-	2	-
203	Millville, ...	2,031	-	-	-	-	-	-	-	-	-	-	-	-
204	Rutland, ...	2,022	-	-	-	-	-	-	-	-	-	-	-	-
205	Ashburnham, ...	2,017	-	-	-	-	-	-	-	-	1	-	5	-
206	Merrimac, ...	2,017	1	-	-	-	2	1	-	-	6	3	12	4
207	Upton, ...	2,007	-	-	-	-	2	1	-	-	1	-	4	-
208	Hamilton, ...	1,988	-	-	-	-	4	-	-	-	-	1	3	-
209	Brookfield, ...	1,937	-	-	-	-	-	-	-	-	-	-	5	-
210	Sherborn, ...	1,923	1	-	-	-	1	-	-	-	12	10	-	-
211	Coleman, ...	1,904	1	-	-	-	1	-	-	-	3	1	-	-
212	Northfield, ...	1,900	-	-	-	-	9	-	-	-	-	-	1	-
213	Sheffield, ...	1,900	1	-	-	-	-	-	-	-	-	-	-	-
214	Wayland, ...	1,886	-	-	-	-	-	-	-	-	-	-	-	-
215	Raynham, ...	1,882	3	-	-	-	2	-	-	-	-	1	7	1
216	Stockbridge, ...	1,875	-	-	-	-	-	-	-	-	-	-	-	-
217	Northborough, ...	1,868	-	-	3	2	5	-	-	-	-	1	25	-
218	Longmeadow, ...	1,866	-	-	-	-	1	1	-	-	-	-	-	-
219	Townsend, ...	1,854	12	-	-	-	-	-	-	-	-	-	125	1
220	Freetown, ...	1,823	1	-	-	-	7	1	-	-	-	-	2	-
221	Westminster, ...	1,796	-	-	-	-	3	-	-	-	-	-	-	-
222	Lunenburg, ...	1,791	6	-	1	1	-	-	-	-	3	1	52	-
223	Lakeville, ...	1,785	-	-	-	-	-	-	-	-	5	-	-	-

to the Public Health, 1919 — Continued.

33A		7		22-29		30-35		1		3		100		19C		33C		37		10		Line No.
Ophthal- mia Neonatorum.		Scarlet Fever.		Tuber- culosis, Pulmo- nary.		Tuber- culosis, Other Forms.		Ty- phoid Fever.		Whoop- ing Cough.		Septic Sore Throat.		Mumps		Gonor- rhea.		Syph- ilis.		Influ- enza.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
-	-	14	-	2	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	4	-	164
-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	165
-	-	3	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	166
-	-	4	-	1	7	-	-	-	-	2	-	-	-	-	-	-	-	-	-	80	-	167
-	-	1	-	1	3	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	1	168
-	-	29	-	3	2	-	-	-	-	1	-	2	-	14	-	-	-	-	-	9	1	169
-	-	9	-	6	2	-	1	1	-	40	-	-	-	-	-	6	-	3	1	9	3	170
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	171
-	-	17	-	5	3	1	1	1	-	19	-	-	-	2	-	4	-	-	-	88	-	172
-	-	7	-	2	2	-	1	1	-	3	2	-	-	9	-	3	-	6	-	31	1	173
-	-	16	-	4	2	1	2	-	-	-	1	-	-	-	-	1	-	-	-	-	1	174
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	175
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	176
1	-	4	-	4	1	5	-	-	-	44	-	-	-	7	-	59	-	94	-	83	2	177
-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-	178
-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	13	3	179
1	-	4	-	3	1	-	-	1	-	1	-	-	-	1	-	2	-	-	-	102	1	180
-	-	12	-	10	5	-	-	-	-	3	-	2	-	3	-	-	-	-	-	81	-	181
-	-	3	-	4	-	1	2	-	-	2	-	-	-	3	-	-	-	-	-	30	-	182
9	-	267	5	113	366	6	26	47	7	418	9	11	3	145	-	112	-	19	4	2121	149	183
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	184
-	-	-	-	-	3	-	-	-	-	-	-	-	-	24	-	-	-	-	-	5	4	185
-	-	15	-	2	1	-	-	-	-	5	-	-	-	-	-	-	-	-	-	27	-	186
-	-	5	-	1	-	-	-	1	-	5	-	-	-	8	-	2	-	-	-	15	2	187
-	-	1	-	3	4	-	-	-	-	-	-	-	-	1	-	1	-	-	-	10	3	188
-	-	4	-	3	1	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	189
-	-	9	-	3	1	-	-	-	-	34	-	-	-	10	-	-	-	1	-	27	3	190
-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	66	1	191
-	-	1	-	2	3	-	-	1	-	9	-	-	-	-	-	1	-	-	-	52	1	192
-	-	1	-	4	2	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	4	193
-	-	1	-	1	-	-	-	2	-	4	-	-	-	-	-	4	-	1	-	10	-	194
-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	56	3	195
-	-	5	-	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	196
-	-	-	-	-	-	1	-	-	-	16	-	-	-	-	-	2	-	-	-	45	2	197
-	-	5	-	3	2	-	-	-	-	3	-	-	-	-	-	-	-	-	-	7	2	198
-	-	3	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	77	-	199
-	-	1	-	1	-	-	-	-	-	5	-	-	-	12	-	1	-	-	-	34	3	200
-	-	3	-	-	-	1	-	1	-	-	-	-	-	5	-	-	-	-	-	6	-	201
-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	202
-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	203
-	-	9	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204
-	-	-	-	2	4	-	-	-	-	-	-	-	-	1	-	6	-	-	-	29	-	205
-	-	-	-	4	1	-	-	1	-	2	-	-	-	-	-	1	-	1	-	11	1	206
-	-	-	-	1	2	-	-	-	-	-	-	-	-	4	-	-	-	-	-	6	1	207
-	-	1	-	4	2	-	-	4	2	-	-	-	-	-	-	2	-	-	-	1	3	208
-	-	3	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	209
1	-	9	2	-	-	-	-	-	-	22	-	-	-	-	-	-	-	-	-	159	1	210
-	-	-	-	1	1	-	-	1	-	1	-	-	-	1	-	2	-	-	-	5	3	211
-	-	-	-	1	-	-	-	-	-	6	1	-	-	4	-	-	-	-	-	-	-	212
-	-	5	-	2	3	-	-	2	1	1	-	-	-	-	-	1	-	-	-	18	3	213
-	-	15	-	-	1	-	-	3	-	-	-	-	-	3	-	4	-	-	-	7	2	214
-	-	3	-	1	1	-	2	-	-	-	-	-	-	3	-	1	-	-	-	2	-	215
-	-	2	-	2	1	-	-	1	-	-	-	-	-	3	-	3	-	-	-	39	1	216
-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	1	217
-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	16	1	218
-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	2	219
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	220
-	-	1	-	-	-	-	1	2	-	-	-	-	-	1	-	1	-	-	-	-	1	221
-	-	-	-	-	-	-	-	-	-	4	-	-	-	4	-	1	-	-	-	21	5	222
-	-	3	-	-	120	-	-	-	-	-	-	-	-	-	-	1	-	-	-	21	2	223

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Pox.		Ep. Cere- bro- spinal Menin- gitis.		Diph- theria.		Ger- man Mea- sles.		Lobar Pneu- monia.		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
224	Salisbury, ...	1,767	-	-	-	1	-	-	1	-	3	2	1	-
225	Chatham, ...	1,755	-	-	-	-	2	-	-	-	1	1	2	-
226	Hanson, ...	1,746	-	-	-	-	-	-	-	-	-	-	-	-
227	Dennis, ...	1,742	-	-	-	-	-	-	-	-	-	-	2	-
228	Carver, ...	1,734	-	-	-	-	-	-	-	-	-	-	-	-
229	Essex, ...	1,724	-	-	-	-	-	-	-	-	1	1	1	-
230	Marshfield, ...	1,713	-	-	-	-	-	-	-	-	1	1	-	-
231	Norwell, ...	1,693	18	-	1	1	-	-	-	-	-	-	-	-
232	Newbury, ...	1,682	1	-	-	-	4	1	1	-	-	-	-	-
233	Southwick, ...	1,655	-	-	-	-	5	-	-	1	1	1	1	-
234	Westwood, ...	1,600	4	-	-	-	1	1	-	-	1	1	1	-
235	Rowley, ...	1,577	1	-	-	-	2	1	-	-	-	-	-	-
236	West Newbury, ...	1,576	-	-	-	-	1	-	-	1	1	-	-	-
237	Buckland, ...	1,565	-	-	-	-	2	-	-	1	3	-	-	-
238	Cheshire, ...	1,560	-	-	-	-	-	-	-	1	1	1	-	-
239	Nahant, ...	1,559	1	-	-	-	2	1	-	-	-	-	8	-
240	Norfolk, ...	1,528	-	-	-	-	6	-	-	3	-	-	2	-
241	Marion, ...	1,508	-	-	-	-	2	-	-	-	-	11	-	-
242	North Reading, ...	1,489	-	-	-	-	1	1	-	-	1	-	-	-
243	Millis, ...	1,479	-	-	-	-	5	1	-	-	2	-	-	-
244	Bedford, ...	1,478	-	-	-	-	3	1	-	-	-	-	-	-
245	Sunderland, ...	1,472	-	-	-	-	-	-	-	-	1	-	-	-
246	Shelburne, ...	1,471	-	-	-	-	-	-	-	-	-	-	-	-
247	Middleton, ...	1,459	-	-	-	-	-	-	-	-	-	-	18	-
248	Mattapoisett, ...	1,453	-	-	-	-	1	-	-	2	1	9	-	-
249	Sterling, ...	1,441	7	-	-	-	-	-	-	3	3	17	-	-
250	Tisbury, ...	1,433	-	-	-	-	1	1	-	5	3	41	-	-
251	Plainville, ...	1,429	-	-	-	-	-	-	-	-	2	-	-	-
252	Lincoln, ...	1,424	-	-	-	-	-	-	-	-	-	-	-	-
253	Yarmouth, ...	1,411	3	-	-	-	-	-	-	-	-	1	-	-
254	Huntington, ...	1,387	-	-	-	-	-	-	-	-	-	-	-	-
255	Oak Bluffs, ...	1,380	1	-	-	-	-	-	-	2	1	30	-	-
256	Hinsdale, ...	1,375	-	-	-	-	-	-	-	-	-	-	-	-
257	West Boylston, ...	1,360	-	-	-	-	2	-	5	1	2	8	-	-
258	Edgartown, ...	1,348	-	-	-	-	4	-	-	-	-	6	-	-
259	Whately, ...	1,346	-	-	-	-	6	-	-	-	1	-	-	-
260	Sandwich, ...	1,340	2	-	-	-	3	-	-	2	1	5	-	-
261	Pembroke, ...	1,337	-	-	-	-	-	-	-	-	1	-	-	-
262	Sturbridge, ...	1,332	-	-	-	-	2	-	-	-	1	2	-	-
263	Chester, ...	1,315	-	-	-	-	-	-	-	-	-	1	-	-
264	Lynnfield, ...	1,291	-	-	-	-	-	-	-	-	-	2	-	-
265	West Stockbridge, ...	1,281	-	-	-	-	-	-	-	-	-	1	-	-
266	Sudbury, ...	1,278	-	-	1	1	-	-	-	-	-	-	-	-
267	West Brookfield, ...	1,255	-	-	-	-	2	-	-	-	1	-	-	-
268	Orleans, ...	1,242	1	-	-	-	-	-	-	-	1	-	-	-
269	Littleton, ...	1,228	-	-	-	-	1	-	1	1	-	7	-	-
270	Russell, ...	1,222	-	-	-	-	-	1	-	-	1	-	-	-
271	Rochester, ...	1,219	-	-	-	-	2	-	-	-	-	8	-	-
272	Conway, ...	1,212	-	-	-	-	2	-	-	-	-	-	-	-
273	Lanesborough, ...	1,207	-	-	-	-	-	-	-	-	-	-	-	-
274	Erving, ...	1,185	1	-	-	-	-	-	-	-	1	7	-	-
275	Topsfield, ...	1,173	-	-	-	-	-	-	1	-	2	1	-	-
276	Dover, ...	1,168	1	-	-	-	1	-	-	-	-	-	-	-
277	Harvard, ...	1,163	1	-	-	-	1	-	-	-	1	-	-	-
278	Stow, ...	1,136	1	-	-	-	-	-	-	-	2	5	-	-
279	Wenham, ...	1,118	-	-	-	-	-	-	-	-	-	-	-	-
280	Hubbardston, ...	1,093	-	-	-	-	-	-	-	-	-	-	-	-
281	Tyngsborough, ...	1,084	-	-	-	-	3	-	1	-	2	8	6	1
282	Clarksburg, ...	1,035	-	-	-	-	-	-	-	-	1	-	-	-
283	Ashfield, ...	1,023	-	-	-	-	-	-	-	-	-	-	-	-
284	Southampton, ...	1,017	-	-	1	-	-	-	-	-	-	-	-	-
285	Brimfield, ...	992	-	-	-	-	-	-	-	-	-	-	-	-
286	Becket, ...	985	-	-	-	-	-	-	-	-	-	-	-	-

to the Public Health, 1919 — Continued.

[illegible]

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Pox.		Ep. Cere- bro- spinal Menin- gitis.		Diph- theria.		Ger- man Mea- sles.		Lobar Pneu- monia.		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
287	Mendon.	979	-	-	-	-	-	-	-	-	2	-	-	-
288	Berkley.	973	-	-	-	-	-	-	-	-	1	-	-	-
289	Gill.	959	6	-	-	-	-	-	-	-	-	-	1	-
290	Charlemont.	956	-	-	-	-	-	-	-	-	-	-	-	-
291	Ashby.	952	-	-	-	-	-	-	-	-	-	-	-	-
292	New Marlborough.	950	-	-	-	-	-	-	-	-	-	-	-	-
293	Royalston.	921	2	-	-	-	-	-	-	-	2	1	-	-
294	Brewster.	910	-	-	-	-	-	-	-	-	-	-	-	-
295	Burlington.	886	-	-	-	-	-	-	-	-	-	-	-	-
296	Granby.	883	-	-	-	-	-	-	-	-	1	2	-	-
297	Wellfleet.	864	-	-	-	-	-	-	-	-	2	-	1	-
298	Boylston.	842	-	-	-	-	1	-	-	-	-	-	2	-
299	Bernardston.	832	-	-	-	-	-	-	-	-	-	-	-	-
300	Berlin.	830	-	-	-	-	-	-	-	-	-	-	-	-
301	Leverett.	821	1	-	-	-	2	-	-	1	-	-	-	-
302	Granville.	788	-	-	-	-	-	-	-	-	-	-	-	-
303	Princeton.	784	-	-	-	-	-	-	-	-	-	1	11	-
304	Bolton.	772	2	-	-	-	-	-	-	-	-	-	-	-
305	Enfield.	748	8	-	-	-	-	-	-	-	-	-	-	-
306	Halifax.	713	-	-	-	-	-	-	-	-	-	-	-	-
307	Boxford.	710	1	-	-	-	-	-	-	-	2	1	6	-
308	Petersham.	702	-	-	-	-	-	-	-	-	-	1	-	-
309	Dana.	691	1	-	-	-	-	-	-	2	-	-	1	-
310	Hampden.	691	-	-	-	1	-	-	-	-	-	-	-	-
311	Cummington.	681	-	-	-	-	-	-	-	-	-	-	-	-
312	Truro.	671	2	-	-	-	-	-	-	-	-	-	3	-
313	Worthington.	660	-	-	2	-	-	-	-	-	-	-	-	-
314	Plympton.	632	-	-	-	-	-	-	-	-	-	-	-	-
315	New Salem.	613	-	-	-	-	-	2	-	-	-	1	-	-
316	Egremont.	595	-	-	-	-	-	-	-	-	-	-	-	-
317	Chesterfield.	580	-	-	-	-	-	-	-	-	-	-	-	-
318	Eastham.	567	-	-	-	-	-	-	-	-	-	-	-	-
319	Sandisfield.	562	-	-	-	-	-	-	-	-	-	1	-	-
320	Hancock.	556	-	-	-	-	-	-	-	-	-	1	-	-
321	Blandford.	543	-	-	-	-	-	1	-	-	-	1	-	-
322	Savoy.	542	-	-	-	-	-	-	-	-	-	-	-	-
323	Pelham.	525	-	-	-	-	1	-	-	-	-	-	2	-
324	Paxton.	517	-	-	1	1	-	1	-	-	-	-	-	-
325	Oakham.	506	-	-	-	-	-	-	-	-	1	1	1	-
326	Richmond.	492	-	-	-	-	-	-	-	-	-	-	-	-
327	Warwick.	477	-	-	-	-	-	-	-	2	1	-	-	-
328	Florida.	453	-	-	-	-	-	-	-	-	-	-	-	-
329	West Tisbury.	445	1	-	-	-	1	-	-	-	-	-	-	-
330	New Braintree.	444	-	-	-	-	2	-	-	-	-	1	-	-
331	Carlisle.	439	-	-	-	-	-	-	-	-	-	1	-	-
332	Westhampton.	435	-	-	-	-	-	-	-	-	-	-	-	-
333	Hawley.	431	-	-	-	-	-	-	-	-	-	-	-	-
334	Heath.	413	-	-	-	-	-	-	-	-	-	-	-	-
335	Greenwich.	405	-	-	-	-	-	-	-	1	-	-	-	-
336	Otis.	400	-	-	-	-	1	-	-	-	-	-	-	-
337	Rowe.	398	-	-	-	-	-	-	-	-	-	-	-	-
338	Leyden.	361	-	-	-	-	2	-	-	-	-	-	-	-
339	Phillipston.	360	-	-	-	-	-	-	-	-	-	-	-	-
340	Plainfield.	350	-	-	-	-	-	-	-	-	-	-	5	-
341	Windsor.	350	-	-	-	-	-	-	-	-	-	-	-	-
342	Monroe.	338	-	-	-	-	-	-	-	-	-	1	-	-
343	Boxborough.	334	-	-	-	-	-	-	-	-	-	1	-	-
344	Monterey.	333	-	-	-	-	-	-	-	-	-	-	-	-
345	Wales.	329	-	-	-	-	-	-	-	-	-	-	-	-
346	Dunstable.	324	-	-	-	-	-	-	-	-	-	1	-	-
347	Shutesbury.	313	-	-	-	-	-	-	-	-	-	1	-	-
348	Middlefield.	300	-	-	-	-	-	-	-	-	-	-	-	-
349	Goshen.	297	-	-	-	-	-	-	-	-	-	-	-	-

to the Public Health, 1919 — Continued.

38A		7		28-29		30-35		1		8		100		19C		33C		37		10		Line No.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	1	287
-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	288
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	289
-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	290
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	2	291
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	292
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	4	2	293
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	294
-	-	4	-	-	4	-	-	-	-	-	-	-	-	-	1	3	-	-	-	1	1	295
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	296
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-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	299
-	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	300
-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	301
-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	302
-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	303
-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	304
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	305
-	-	3	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	306
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	307
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-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	1	310
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-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	316
-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	40	2	317
-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	318
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-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	325
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-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	344
-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	345
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	346
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	347
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	348
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	349

Cases and Deaths from Diseases Dangerous

Line No.	CITIES AND TOWNS GROUPED IN ORDER OF POPULATION.	Popu- lation esti- mated as of July 1, 1919.	19A		61A		9		19B		92		6	
			Chicken Fox.		Ep. Cere- bro- spinal Menin- gitis.		Diph- theria.		Ger- man Meas- les.		Lobar Pneu- monia.		Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
350	Chilmark, ...	293	-	-	-	-	1	-	-	-	1	-	-	-
351	Wendell, ...	292	-	-	-	-	1	-	-	-	1	-	-	-
352	Prescott, ...	282	-	-	-	-	-	-	-	-	-	-	-	-
353	Tyringham, ...	282	-	-	-	-	-	-	-	-	-	-	-	-
354	Washington, ...	273	-	-	-	-	-	-	-	-	-	1	-	-
355	Alford, ...	267	-	-	-	-	-	-	-	-	-	-	-	-
356	Mashpee, ...	259	-	-	-	-	-	-	-	-	1	-	-	-
357	Montgomery, ...	242	-	-	-	-	-	-	-	-	-	-	-	-
358	Tolland, ...	216	-	-	-	-	-	-	-	-	-	-	-	-
359	Gay Head, ...	187	-	-	-	-	-	-	-	-	-	-	-	-
360	Holland, ...	171	-	-	-	-	1	-	-	-	-	-	-	-
361	Peru, ...	161	-	-	-	-	-	-	-	-	-	-	-	-
362	Gosnold, ...	159	-	-	-	-	-	-	-	-	-	-	-	-
363	New Ashford, ...	92	-	-	-	-	-	-	-	-	-	-	-	-
364	Mount Washington, ...	82	-	-	-	-	-	-	-	-	-	-	-	-
365	CAMP DEVENS, ...	-	10	-	7	2	17	-	11	-	55	6	6	-
366	STATE INFIRMARY, TEWKSBURY, ...	-	30	-	-	1	22	2	-	-	21	17	2	-

In addition to the above there occurred 3 cases of actinomycosis:—

	Cases.	Deaths.
Boston, ...	2	-
Taunton, ...	1	-

66 cases of anterior poliomyelitis, with 17 deaths:—

	Cases.	Deaths.
Abington, ...	1	-
Athol, ...	1	1
Belmont, ...	1	-
Boston, ...	13	3
Bridgewater, ...	2	1
Brockton, ...	1	-
Cambridge, ...	-	1
Carlisle, ...	1	-
Chelmsford, ...	-	1
Clinton, ...	1	-
Dedham, ...	1	-
Easthampton, ...	1	-
Everett, ...	2	-
Fall River, ...	1	-
Gloucester, ...	1	1
Great Barrington, ...	1	-
Holliston, ...	1	-
Holyoke, ...	2	1
Lawrence, ...	1	-
Lowell, ...	0	3
Lynn, ...	4	-
Medford, ...	1	-
Melrose, ...	1	-
Methuen, ...	1	-
Milford, ...	1	-
Needham, ...	1	1
New Bedford, ...	1	2
Newton, ...	1	-
North Adams, ...	1	-
Norwood, ...	-	1
Palmer, ...	1	-
Revere, ...	1	-
Scituate, ...	1	-

	Cases.	Deaths.
Somerville, ...	1	-
Springfield, ...	2	1
Swampscott, ...	2	-
Warwick, ...	1	-
West Newbury, ...	1	-
Weymouth, ...	1	-
Winthrop, ...	1	-
Worcester, ...	1	-

18 cases of anthrax, with 1 death:—

	Cases.	Deaths.
Boston, ...	1	-
Canton, ...	1	-
Chelsea, ...	2	-
Hudson, ...	2	-
Lynn, ...	2	-
Peabody, ...	2	1
Salem, ...	3	-
Somerville, ...	1	-
Weymouth, ...	1	-
Woburn, ...	2	-
Worcester, ...	1	-

54 cases of dog bite (requiring anti-rabic treatment):—

	Cases.	Deaths.
Attleboro, ...	1	-
Berkley, ...	1	-
Beverly, ...	1	-
Brockton, ...	2	-
Cambridge, ...	1	-
Dartmouth, ...	1	-
Dighton, ...	3	-
Fall River, ...	9	-
Fitchburg, ...	1	-
Groton, ...	2	-
Lawrence, ...	1	-
Lowell, ...	8	-
Lunenburg, ...	1	-
Middleborough, ...	1	-
New Bedford, ...	4	-

to the Public Health, 1919 — Concluded.

32A		7		22-29		30-35		1		8		100		19C		32C		37		10		Line No.
Ophthal- mia Neona- torum.		Scarlet Fever.		Tuber- culosis, Pulmo- nary.		Tuber- culosis, Other Forms.		Ty- phoid Fever.		Whoop- ing Cough.		Septic Sore Throat.		Mumps		Gonor- rhea.		Syph- ilis.		Influ- enza.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1	350
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	351
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	352
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	353
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	354
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	355
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-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	362
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	363
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	364
-	-	23	-	-	9	-	1	2	-	-	-	-	-	114	-	269	-	272	1	1	-	365
3	-	10	-	131	165	21	6	2	-	16	-	1	1	3	-	119	-	37	19	3	5	366

		Cases.	Deaths.			Cases.	Deaths.
Rehoboth, ...		1	-	Camp Devens, ...		3	-
Swansea, ...		8	-	Chelsea, ...		-	1
Taunton, ...		1	-	Dedham, ...		2	-
Templeton, ...		4	-	Fall River, ...		1	-
Winthrop, ...		1	-	Frammingham, ...		11	-
Worcester, ...		2	-	Franklin, ...		1	-
23 cases of dysentery, with 9 deaths:—				Haverhill, ...		1	-
Adams, ...		1	-	Lawrence, ...		1	-
Agawam, ...		-	1	Lexington, ...		1	-
Beltingham, ...		-	1	Lowell, ...		1	1
Boston, ...		6	1	Malden, ...		1	-
Brookline, ...		1	-	Mansfield, ...		1	-
Cambridge, ...		2	-	Middleborough, ...		1	-
Camp Devens, ...		1	-	Milford, ...		19	-
Fall River, ...		-	2	Needham, ...		1	-
New Bedford, ...		1	-	Newton, ...		1	-
Newburyport, ...		2	1	Northampton, ...		1	1
North Adams, ...		1	-	Northbridge, ...		5	-
Northampton, ...		1	-	Springfield, ...		1	-
Pittsfield, ...		-	1	Wayland, ...		1	-
Provincetown, ...		-	1	Wellesley, ...		1	-
Quincy, ...		2	-	Weymouth, ...		1	-
Salem, ...		1	-	Winthrop, ...		2	-
Scituate, ...		1	-	13 cases of pellagra, with 15 deaths:—			
Sterling, ...		-	1	Boston, ...		3	1
Topshfield, ...		1	-	Danvers, ...		2	4
Westport, ...		2	-	Foxborough, ...		1	-
3 cases of leprosy, with 1 death:—				Haverhill, ...		2	2
Boston, ...		3	-	Medford, ...		-	1
Chelsea, ...		-	1	Melrose, ...		1	1
72 cases of malaria, with 4 deaths:—				Northampton, ...		1	-
Barre, ...		1	-	Pepperell, ...		-	1
Boston, ...		11	-	Somerville, ...		1	-
Brookton, ...		2	1	Taunton, ...		-	1
				Westborough, ...		1	2
				Worcester, ...		1	1
				Wrentham, ...		-	1

1 case of rabies, with 1 death:— Cases. Deaths.

Fall River, ... 1 1

40 cases of smallpox, with 2 deaths:—

Belmont, ...	1	—
Boston, ...	14	—
Cambridge, ...	1	—
Edgartown, ...	1	—
Everett, ...	1	—
Fall River, ...	2	2
Frammingham, ...	1	—
Gardner, ...	2	—
Gloucester, ...	5	—
Lawrence, ...	1	—
Lowell, ...	1	—
Ludlow, ...	4	—
Quincy, ...	1	—
Springfield, ...	5	—

21 cases of tetanus, with 22 deaths:—

Adams, ...	—	1
Amesbury, ...	—	1
Barnstable, ...	1	—
Boston, ...	1	3
Braintree, ...	1	1
Brookline, ...	—	1
Cambridge, ...	—	1
Concord, ...	1	—
Dedham, ...	1	—
Dracut, ...	—	1
Easthampton, ...	1	1
Fairhaven, ...	1	—
Fall River, ...	1	1
Franklin, ...	1	1

	Cases.	Deaths.
Georgetown, ...	—	1
Lynn, ...	2	1
Malden, ...	1	1
Milton, ...	—	1
New Bedford, ...	2	1
Peabody, ...	—	1
Pittsfield, ...	2	2
Quincy, ...	1	—
Somerville, ...	2	1
Worcester, ...	2	1

3 cases of trichinosis:—

Boston, ... 3 —

72 cases of trachoma:—

Attleboro, ...	1	—
Boston, ...	41	—
Cambridge, ...	4	—
Chelsea, ...	2	—
Chicopee, ...	1	—
Fall River, ...	1	—
Fitchburg, ...	2	—
Haverhill, ...	1	—
Lawrence, ...	2	—
Lowell, ...	3	—
Lynn, ...	1	—
Malden, ...	1	—
Newton, ...	1	—
Northampton, ...	2	—
Norwood, ...	1	—
Peabody, ...	1	—
Somerville, ...	2	—
Watertown, ...	1	—
Williamsburg, ...	1	—
Worcester, ...	3	—

DIVISION OF BIOLOGIC LABORATORIES

MILTON J. ROSENAU, M.D., *Director*

W. A. HINTON, M.D., *Assistant Director*

A. N. ALLEN, M.D., *Assistant Director*



REPORT OF DIVISION OF BIOLOGIC LABORATORIES.

It is becoming increasingly clear that the quarters for the Antitoxin and Vaccine Laboratory, at Forest Hills, are inadequate both in size and equipment to meet the present situation. These buildings were erected fifteen years ago for the purpose of making diphtheria antitoxin and vaccine virus. Since then both the variety and amounts of vaccines and serums made at Forest Hills have increased by leaps and bounds. It is also very clear that further developments in the line of biologic products which have to do with the diagnosis, prevention and cure of disease will progress during the next decade. The need of new quarters and adequate equipment is pressing.

The Antitoxin and Vaccine Laboratory, during the fiscal year covered by this report, made and distributed products which would have cost the State \$99,270.80. This was accomplished with a total appropriation of \$39,800. This was done only by strict economies and careful planning.

The report of the Antitoxin and Vaccine Laboratory and the report of operations of the Wassermann Laboratory follow.

ANTITOXIN AND VACCINE LABORATORY.

Normal Diphtheria Antitoxin.

Number of liters in stock Dec. 1, 1918, ...	116.087
Number of liters in stock Nov. 30, 1919, ...	72.300
Number of liters produced Dec. 1, 1918, to Nov. 30, 1919, ...	602.280
Number of liters distributed Dec. 1, 1918, to Nov. 30, 1919, ...	646.067
Number of liters distributed Dec. 1, 1917, to Nov. 30, 1918, ...	629.086
Number of 1,000 units distributed Dec. 1, 1918, to Nov. 30, 1919, ...	143,101
Number of 1,000 units distributed Dec. 1, 1917, to Nov. 30, 1918, ...	61,013

Concentrated Diphtheria Antitoxin.

Number of liters in stock Dec. 1, 1918, ...	3.100
Number of liters in stock Dec. 1, 1919, ...	60.000
Number of liters produced in 1918 to Nov. 30, 1919, ...	165.950
Number of liters distributed in 1918 to Nov. 30, 1919, ...	109.050
Number of liters distributed in 1917 to Nov. 30, 1918, ...	234.350
Number of 1,000 units distributed Dec. 1, 1918, to Nov. 30, 1919, ...	16,028
Number of 1,000 units distributed Dec. 1, 1917, to Nov. 30, 1918, ...	122,026

Diphtheria Horse Tapping.

Number of liters of blood drawn Dec. 1, 1918, to Nov. 30, 1919,	2,444.800
Number of liters of serum yield Dec. 1, 1918, to Nov. 30, 1919, .	740.225

Diphtheria Horses.

Number of diphtheria horses in stock Dec. 1, 1918, ...	22
Number of diphtheria horses in stock Nov. 30, 1919, ...	25
Number of diphtheria horses yielding antitoxin Nov. 30, 1919, . . .	15
Number of diphtheria horses acquired Dec. 1, 1918, to Nov. 30, 1919,	9
Number of diphtheria horses disposed of Dec. 1, 1918, to Nov. 30, 1919,	7

Antimeningitis Serum.

Number of liters in stock Dec. 1, 1918, ...	11.000
Number of liters in stock Nov. 30, 1919, ...	31.000
Number of liters produced Dec. 1, 1918, to Nov. 30, 1919, ...	86.500
Number of liters distributed Dec. 1, 1918, to Nov. 30, 1919, . . .	67.365
Number of liters distributed Dec. 1, 1917, to Nov. 30, 1918, . . .	69.720
Number of bottles of 15 cubic centimeters each distributed Dec. 1, 1918, to Nov. 30, 1919, ...	4,565
Number of bottles of 15 cubic centimeters each distributed Dec. 1, 1917, to Nov. 30, 1918, ...	4,558

Antimeningitis Horse Tapping.

Number of liters of blood drawn Dec. 1, 1918, to Nov. 30, 1919, .	258.700
Number of liters of serum yield Dec. 1, 1918, to Nov. 30, 1919, .	98.900

Antimeningitis Horses.

Number of meningitis horses in stock Dec. 1, 1918, ...	6
Number of meningitis horses in stock Dec. 1, 1919, ...	6
Number of meningitis horses yielding serum Nov. 30, 1919, . . .	6

Pneumococcus Serum.

Number of liters in stock Dec. 1, 1918, Type I., ...	65.325
Number of liters in stock Nov. 30, 1919, ...	36.925
Number of liters produced Dec. 1, 1918, to Nov. 30, 1919, ...	23.800
Number of liters distributed Dec. 1, 1918, to Nov. 30, 1919, . . .	42.200
Number of bottles of 100 cubic centimeters each distributed Dec. 1, 1918, to Nov. 30, 1919, ...	422
Number of bottles of 100 cubic centimeters each distributed Dec. 1, 1917, to Nov. 30, 1918, ...	357
Number of liters in stock Dec. 1, 1918, Type II., ...	13.825

Number of liters in stock Nov. 30, 1919, Type II., ...	11.525
Number of liters produced Dec. 1, 1918, to Nov. 30, 1919, Type II.,	18.600
Number of bottles of 100 cubic centimeters each distributed Dec. 1, 1918, to Nov. 30, 1919, ...	209
Number of bottles of 100 cubic centimeters each distributed Dec. 1, 1917, to Nov. 30, 1918, ...	295

Antipneumococcus Serum Tapping.

Number of liters of blood drawn Dec. 1, 1918, to Nov. 30, 1919, . .	71.100
Number of liters of serum yield Dec. 1, 1918, to Nov. 30, 1919, . .	29.900

Antipneumococcus Horses.

Number of pneumococcus horses in stock Dec. 1, 1918, ...	3
Number of pneumococcus horses in stock Nov. 30, 1919, ...	3
Number of pneumococcus horses disposed of Dec. 1, 1918, to Nov. 30, 1919, ...	2

Diphtheria Toxin.

Number of liters of toxin in stock Dec. 1, 1918, ...	64
Number of liters of toxin in stock Nov. 30, 1919, ...	20
Number of liters produced Dec. 1, 1918, to Nov. 30, 1919, ...	539
Average strength of toxin in minimum lethal dose (.006, or used on a basis of .006).	
Culture used, Park No. 8 and Parke, Davis No. 0236.	

General Distribution of Schick Toxin Outfits.

Number of outfits distributed from Dec. 1, 1918, to Nov. 30, 1919, .	96
One outfit contains 100 doses; total doses, 9,600.	

General Distribution of Diphtheria Toxin-Antitoxin Mixture.

Number of ampoules distributed from Dec. 1, 1918, to Nov. 30, 1919 (1 cubic centimeter in each ampoule), ...	508
Distributed from Dec. 1, 1918, to Nov. 30, 1919, 600 cubic centimeters equaling 600 ampoules.	

Calves inoculated and Vaccine Virus produced, Dec. 1, 1918, to Nov. 30, 1919.

DATE OF VACCINATION..	Number of Calves.	Yield of Vaccine (Cubic Centimeters).	Virus (‰ Cubic Centimeter Doses).
1919.			
January 9, ...	1	100	6,000
January 23, ...	1	120	7,200
February 14, ...	1	100	6,000
March 13, ...	1	100	6,000
April 3, ...	1	100	6,000
April 24, ...	2	140	8,400
May 8, ...	1	156	9,360
May 23, ...	1	150	9,000
June 6, ...	1	80	4,800
August 28, ...	1	105	6,300
September 5, ...	2	180	10,800
October 2, ...	1	110	6,600
October 17, ...	1	110	6,600
October 20, ...	1	130	7,800
October 29, ...	1	116	6,960
November 15, ...	1	120	7,200
November 29, ...	1	192	11,520
November 29, ...	1	120	7,200
Totals, ...	19	2,349	140,940

Vaccine Virus, Output by Months Dec. 1, 1918, to Nov. 30, 1919.

MONTH.	Doses (‰ Cubic Centimeters) of Vaccine Virus sent out.
1918.	
December, ...	5,056
1919.	
January, ...	8,816
February, ...	6,195
March, ...	6,715
April, ...	11,028
May, ...	18,905
June, ...	13,895
July, ...	14,957
August, ...	50,080
September, ...	36,785
October, ...	14,350
November, ...	8,025
Total, ...	194,807

Typhoid and Paratyphoid Prophylactic, Output by Months, in One Cubic Centimeter Doses, Dec. 1, 1918, to Nov. 30, 1919.

MONTH.	Typhoid Prophylactic.	Paratyphoid A and B.	Triple Mixture.
1918.			
December, ...	1,262	174	2,066
1919.			
January, ...	1,150	-	1,562
February, ...	900	150	730
March, ...	1,400	168	2,114
April, ...	2,100	150	1,993
May, ...	2,015	75	1,663
June, ...	2,200	214	2,394
July, ...	800	150	6,716
August, ...	750	75	1,850
September, ...	1,550	135	9,456
October, ...	1,068	81	23,487
November, ...	1,575	150	1,800
Totals, ...	16,770	1,522	55,831

WASSERMANN LABORATORY.

The activities of the Wassermann Laboratory have not been unusual during the past year. There have been a few minor changes in personnel designed to make the work more efficient and less expensive. For example, an assistant bacteriologist, employed at a beginning rate of \$1,500 per year, has been replaced by a laboratory assistant at \$900 per year. By careful training, this assistant has been taught to do most of the work formerly done by the higher paid individual without detracting from the quality of the work and in some instances greatly adding to it.

The activity of the United States Public Health Service in venereal disease control has shown the desirability of statistical data with regard to both syphilis and gonorrhea. Although the Wassermann Laboratory has had a wealth of this material to work on; it has been handicapped because of lack of clerical assistance. This work, however, is now proceeding with rapidity, and it is hoped that at a very early date valuable statistical data will be in form for publication.

The following table indicates the comparative number of the different tests during the years 1918 and 1919: —

	1918.	1919.
Wassermann tests, ...	27,534	31,485
Gonococcus fixation tests, ...	-	221
Diagnostic examinations for the Department of Animal Industry: —		
(a) Complement fixation tests for glanders, ...	646	122
(b) Agglutination tests for glanders, ...	215	-
(c) Examinations for rabies, ...	61	84
(d) Pathologic and bacteriologic examinations, ...	45	79

The number of tests and examinations made for the year 1919 is greater than that of the previous year in every case, with the exception of diagnostic examinations for glanders. This exception is due to the fact that very few cases of glanders have been suspected in domestic animals during the past year.

A law was passed in 1917 requiring that certain laboratory tests be made (that the Department of Health might direct) upon the inmates of houses of correction, jails and similar institutions. As a result of the enforcement of this law, an unusual number of Wassermann tests have been made upon the inmates of these institutions. All told, thirteen houses of correction and courts have requested a Wassermann test. The total number of specimens upon which a satisfactory test was made for these agencies was 1,485, of which 241, or 16 per cent, were positive, and 61, or 4.1 per cent, were doubtful. Assuming that the rate of positivity is from 5 to 8 per cent for the population of Massachusetts in general, it is obvious that the criminal class is a real menace to the community from the point of view of the spread of syphilis.

The State-approved venereal clinics outside of Boston with one exception have had their Wassermann tests made in the State laboratory. The total number of specimens submitted from this source during the year was 1,303.

Scientific medicine has given public health officials knowledge upon which laws may be drafted adequate to properly control syphilis. This is not the case with gonorrhea. The treatment of this disease from the venereal aspect is far from satisfactory, while the diagnosis in many instances, especially in the case of females, is notoriously uncertain. The gonococcus fixation test is proving in our hands a valuable aid in the diagnosis of the disease. However, it is not expected that this test will entirely solve this aspect of gonorrhea, and for this reason it is desirable that funds be obtained with which to make a study of this very important public health problem. The Wassermann Laboratory is excellently equipped to carry out such research, and possesses a personnel desirous of studying the problem. It simply needs a small additional amount of money and the authority to undertake its study.

DIVISION OF HYGIENE

MERRILL E. CHAMPION, M.D., *Director*



REPORT OF DIVISION OF HYGIENE.

CHANGES IN PERSONNEL.

There have been various changes in the personnel of this Division during the past year. Miss Pansy V. Besom, chief of the child welfare supervisors, attached to this Department during the war, resigned in February to go with the Red Cross as associate director in the public health nursing section of the New England Division. In April Miss Ellen Atchison, another of the child welfare supervisors, resigned. Miss Ethel M. Ford in April was transferred to the Division of Administration, succeeding Miss Lowe as filing clerk. Mr. Edward H. Williams, for several years draftsman in the Division of Hygiene, resigned to accept a more highly paid position outside of State work. Lastly, Miss Genevieve R. Jules resigned in November to be married. Miss Jules was one of the nurses receiving an appointment early in the history of this Division.

Replacing Miss Ford, Miss Josephine M. Cullen was transferred from the Division of Communicable Diseases to the Division of Hygiene. Mr. John H. McCarthy was appointed to succeed Mr. Williams. Mr. McCarthy is a graduate of the Massachusetts Normal Art School, has been supervisor of drawing for several towns in this State, and has served overseas. Several other new appointments were made during the summer to fill vacancies or new positions. Miss Hazel Wedgwood was appointed temporary health instructor, later being made permanent after a civil service examination list was established. Miss Harriet L. Wedgwood and Miss Helen C. Reilly were obtained from this same list to fill new positions authorized by the Legislature of this year.

When, in April, it was decided to extend the work of this Division to cover the subject of mouth hygiene, Dr. Edwin N. Kent was appointed with the title of Supervisor of Mouth Hygiene. Dr. Kent has been for many years interested in the public health aspect of dental hygiene, having developed, among other things, a standardized series of lectures which have had very wide circulation. At the time of his appointment Dr. Kent was president of the Dental Hygiene Council of Massachusetts. In October Miss Evelyn C. Schmidt was

appointed as temporary health instructor in mouth hygiene, to assist Dr. Kent in his work.

During the period of the agricultural fairs Dr. Mary Putnam of Cambridge was employed by the Division of Hygiene to conduct clinics for children. Dr. Putnam, in addition to excellent training and experience as a pediatrician, had served with the Franco-American Committee for the Care of Children from the Frontier in France during the war.

The Child Conservation Committee, appointed by the Commissioner of Health during the war, completed the large piece of work it set out to do early in the year, and discontinued the employment of its child welfare nurses, the Red Cross appropriation having run out. The members of this committee have, however, agreed to continue as an advisory committee to give the Department the benefit of their valuable advice. The hearty thanks of the Department are due these experts who have so freely given of their time and energy for the improvement of the health of the children of the State.

LINES OF WORK.

During the early part of the year 1918-19 the work of the Division of Hygiene was considerably handicapped by the fact that people had not yet recovered from the effect of the disastrous epidemic of influenza of 1918. This was to be noted, so far as this Division was concerned, chiefly in the infrequency of public meetings. Later in the new year, however, things resumed a more normal aspect. On the whole, the work of the year which is just past has represented a real extension, both in scope and in character. A short description of our various activities will be given under appropriate headings.

Public Health Nursing.

In many ways the activities of our public health nurses represent the most varied and fundamental of our lines of work. Starting in 1915 with two nurses, the Division now employs five. In April, 1919, it was decided that the time had come for a more compact organization of the nurses. Therefore a subdivision of public health nursing was established within the Division of Hygiene. Miss Blanche Wildes, one of our health instructors, was appointed chief of this subdivision. The duties of these nurses have been varied. Lectures, investigations of child welfare problems, and exhibit work have taken them all over the State. A few examples of the type of work they are doing will appear under the various subsequent headings.

Food and its Relationship to Health.

The Division of Hygiene has had a health instructor in foods since 1917. For the first two years the work of this instructor was confined largely to preparing articles on food for publication in bulletin form, and to delivering lectures to public audiences on this same subject. During this time a good deal of valuable educational material was scattered broadcast throughout the State. A very interesting series of posters and stereopticon slides prepared in this connection has been used by various food workers. The effort is now being made to do a broader work by aiding in the co-ordination of the intensive efforts carried on by many different organizations, all having in view the maintenance of health through a proper appreciation of the problem of nutrition. An attempt is now being made by this Division to list the various nutritional clinics of the State, and to devise some adequate method for standardization.

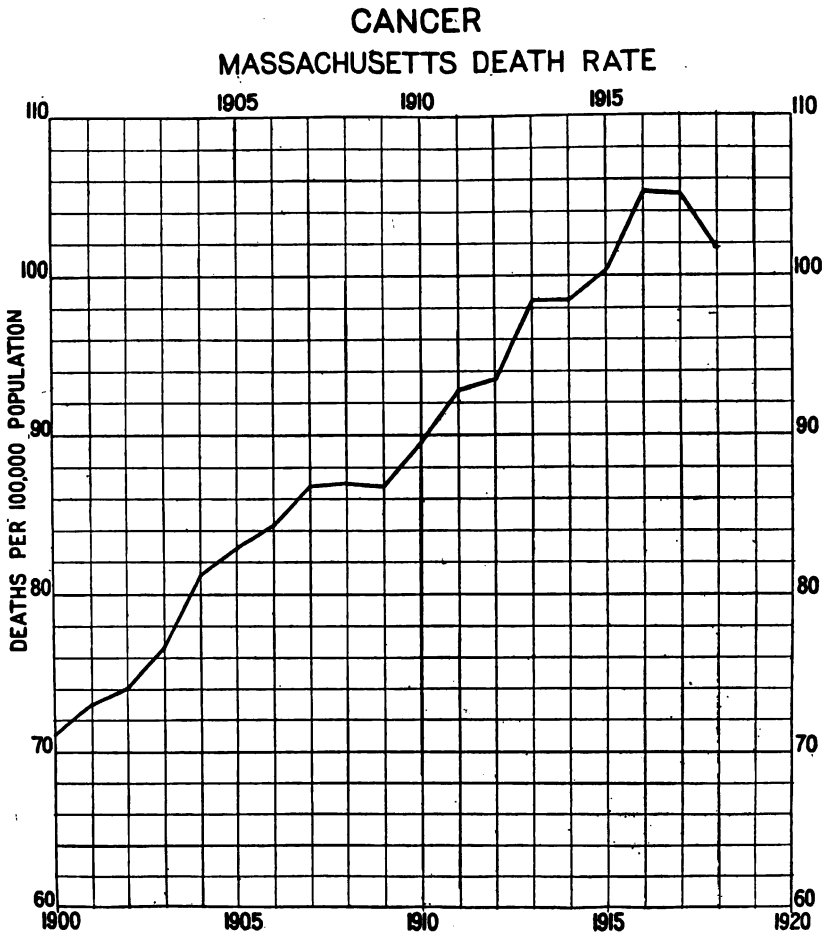
Mouth Hygiene.

Reference has already been made to the appointment of Dr. Kent to develop this very important phase of personal hygiene. It was recognized at once that if anything was to be accomplished the first step would have to be a survey of existing facilities. This has been accomplished. The Division of Hygiene now has a list of all the dental dispensaries in the State, and is receiving a monthly report regularly from each one. Furthermore, we are trying to lend all possible assistance to communities desirous of establishing dental clinics, hoping that thereby a saving will be effected for these communities in time, expense and efficiency. Some educational material has also been prepared and more is in preparation. A good many talks on the care of the mouth have been given, especially to school children, by the health instructor in mouth hygiene.

Cancer Control.

The results obtained from the co-operation between the Cancer Commission of Harvard University and the State Department of Health seemed so desirable that a special appropriation was secured from the Legislature amounting to \$3,000 for the purpose of furnishing diagnostic facilities to physicians, and also for educational propaganda. The Cancer Commission has handled this diagnosis work for us. A special booklet on the subject of cancer is being sent by the

Department of Health to every physician in the State. The accompanying chart shows the trend of the cancer death rate in Massachusetts.



Investigations and Surveys.

It is becoming increasingly apparent that the Division of Hygiene can do good service by making an investigation of some of the problems relating to the health of women and children which have long been neglected. Accordingly, we have begun an inquiry into the status of the midwife problem in Massachusetts. A survey is also being completed of the open-air schools in this State. The imminence of maternity benefit legislation made it necessary for us to gather

information which would be of assistance in the administration of any laws which might be passed. A number of similar lines of investigation are contemplated for the future.

Educational Work.

Our oldest venture in the educational field, our child welfare exhibit, is still proving to be of real value. The original panels which were first used in 1915 were found to be pretty well used up after four years of wear and tear, and were discarded. An entirely new set was prepared, consisting of ten panels, smaller in size and of lighter construction than the ones which they replaced. These are more easily assembled and cost less to ship. Various small posters have been added from time to time. An excellent and unique set of food posters has been developed by the health instructor in foods. The same ground has also been covered with a set of stereopticon slides which are in great demand among food workers outside the Department for use in public talks. A large part of the real value of the exhibit lies in the fact that it can be used as a nucleus around which a health week can be built. The underlying purpose of a health week is to awaken the people of a given community to the importance of health measures in general, and some one measure in particular. The most common object in such a drive is the acquisition of a public health nurse.

Arrangements have been entered into with the Massachusetts Tuberculosis League, the Massachusetts Child Labor Committee, and the League for Preventive Work, whereby the exhibits maintained by these organizations are united with ours during health weeks.

Closely allied with the health weeks have been our visits to certain of the agricultural fairs. This year, with the aid of an automobile truck and a tent, we attended seven of these fairs, showing our exhibits and giving demonstrations on health subjects. An innovation this year was the employment, for the period of the fairs, of a trained pediatrician, who gave an examination to such children as were brought to her by their parents, and who advised the parents regarding the necessity of a visit to the family physician for correction of such physical defects as were brought to light by the examination.

Another innovation at the fairs was the use of a dental hygienist to demonstrate to children and adults the hygiene of the mouth.

During the past year our lecture work has been continued; practically every request for a speaker from any responsible group has been complied with. The District Health Officers and their nursing assistants have shared to a great extent in this service. In addition

to these facilities offered the general public, there has been co-operation with educational and nursing institutions in special lectures on public health subjects.

One of the most potent aids to public health education is unquestionably the moving pictures. A drawback to their use has always been the fact that the standard film requires a booth and a licensed operator, two adjuncts not always to be obtained in a country community. To obviate this difficulty the Division of Hygiene has this year added a pathescope to its equipment. As yet the supply of films of this type is inadequate.

Owing to the fact that the very important subject of school hygiene has never been handled adequately in moving picture form, this Division, during the past year, produced such a film, entitled "The Priceless Gift of Health."

No educational scheme would be complete without the use of written material. During the past year there has been a very great demand for all of our pamphlets. A great many of these have gone to school children. New material issued this year includes "The Importance of Minerals in the Diet;" Diet Cards for Children from Birth to Six Years of Age; "A Few Simple Facts about Digestion;" "Posture in its Relation to Health;" "The 1916 Epidemic of Poliomyelitis;" "The Importance of Mouth Cleanliness;" and "Health Habits."

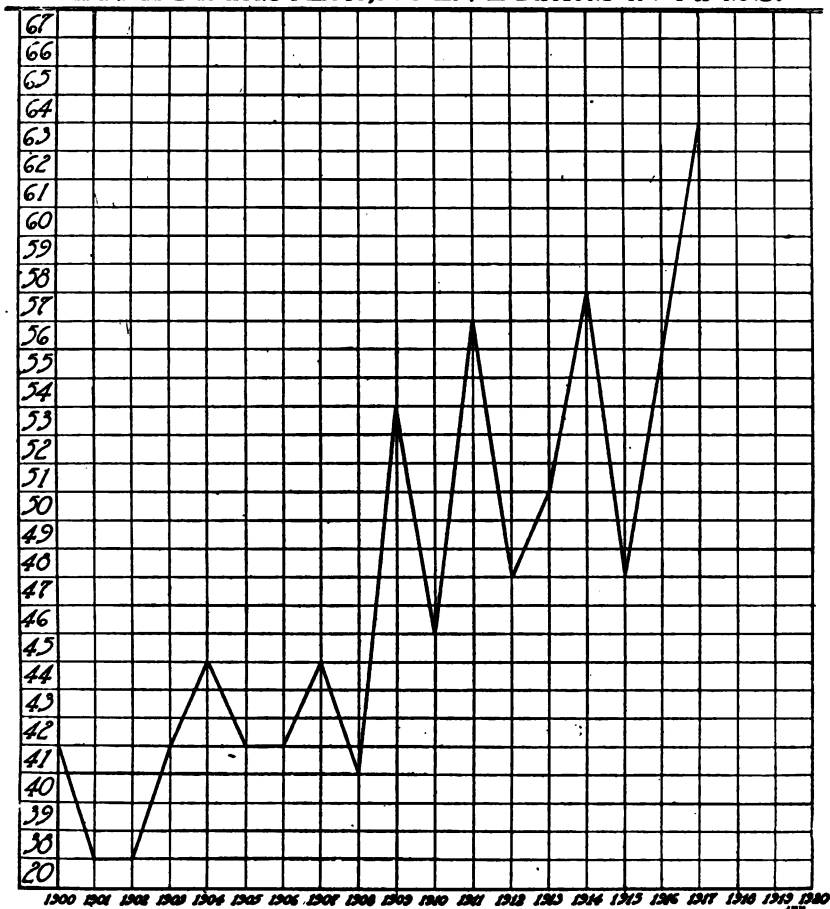
Most far-reaching of all our educational material, perhaps, have been our prenatal and postnatal letters, the latter new this year. Under our present system, prenatal letters are sent to the prospective mother once a month until the baby is born; the postnatal letters are then sent to the mother once a month until the baby is a year old. The names of persons to whom these letters are to be sent come to us through physicians, nurses, social workers, interested friends of patients, and from the patients themselves. We have had 1,071 requests for these letters during the past year. The average has been higher during the last few months.

That prenatal work of the most intensive kind is needed is conclusively shown by the charts which follow. Deaths among women from causes directly referable to childbirth are increasing in Massachusetts. The extraordinarily high rate for 1918 undoubtedly was due to the influenza epidemic, but for a number of years the trend has been undeniably upward. This upward trend, in spite of modern advances in preventive medicine, is hard to explain. It would seem as if the stress of modern life, with its changing conditions, were tending to render maternity a pathological state more rapidly than counterbalance can be applied through better obstetrics.

The same tendency may be perceived in the infant mortality, not as a whole, but during the first month. The total rate for the first year of life shows in this State a satisfactory decrease, due largely to a lessening of the number of deaths caused by the diarrheal

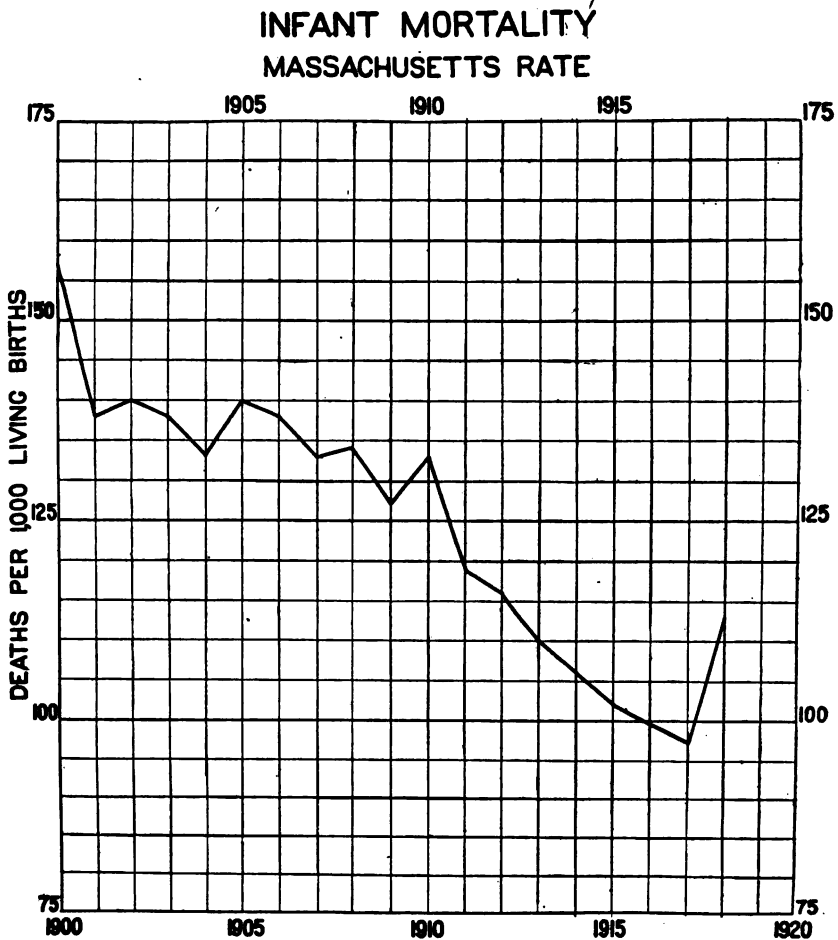
THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH

MATERNAL DEATHS PER 10,000 LIVE BIRTHS IN MASS.



diseases. The rate for the year 1918 shows an atypical increase, as might have been expected; the indications are that the 1919 rate will fall below the 1917 rate. None the less, our admittedly imperfect figures show that the rate for the first month of life does not share in this satisfactory decrease. Those interested in a further study of

the infant mortality will find information of value in the report of the Secretary of State, in whose office the vital statistics of the State are collected. However, the slowness with which individual cities and towns report their births to the State renders the compilation of recent figures almost out of the question.

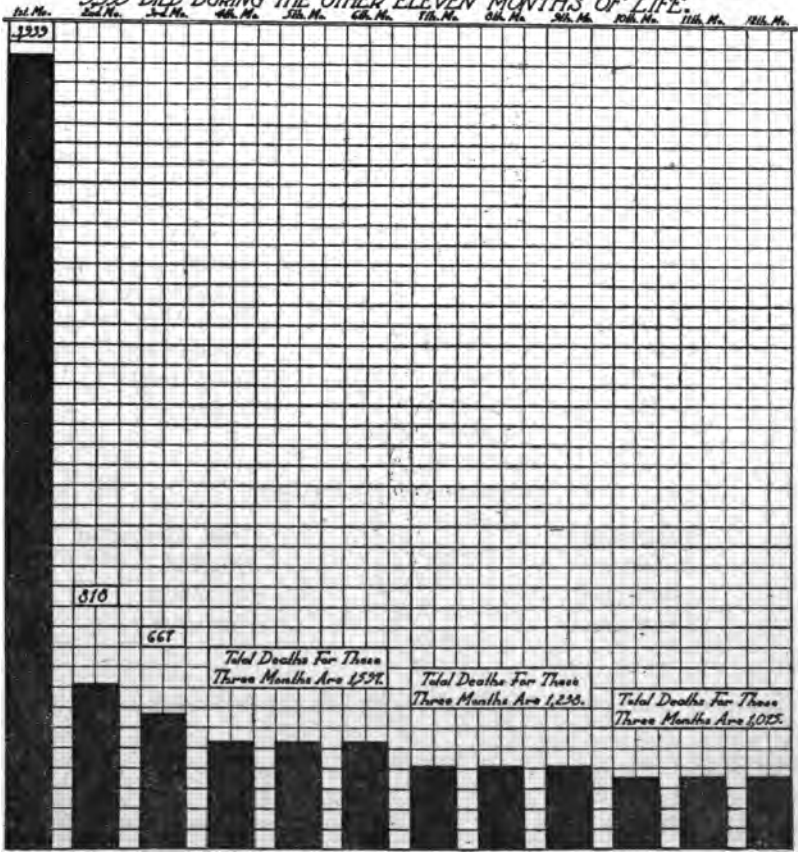


In view of the fact that the maternal mortality is increasing, and that the infant mortality of the first few weeks is not coming down, it would seem imperative that steps be taken to extend the employment of prenatal care as the only means likely to influence these deplorable conditions.

Our health column in the newspapers has now been extended to

include seven newspapers. I feel that this is of distinct value, though the type of question that comes in shows conclusively that the general public has not as yet any real appreciation of the need of prevention

THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC HEALTH
DEATHS UNDER ONE YEAR OF AGE, BY MONTHLY
AGE GROUPS, IN MASSACHUSETTS.
TOTAL DEATHS UNDER ONE YEAR. (1916) 9,334.
3,339 BABIES DIED DURING FIRST MONTH OF LIFE IN MASSACHUSETTS.
5,995 DIED DURING THE OTHER ELEVEN MONTHS OF LIFE.



as compared with the cure of disease. This newspaper service has for its object assistance to the public in the ways to health. It does not contemplate offering treatment, which is the function of the practicing physician.

Expansion for the Coming Year.

The work done the past year suggests new avenues for the coming year. Among these I would place, first, the need for a whole-time physician to conduct clinics for children, especially in the rural sections of the State. Again, our mouth hygiene work, which has now a fair start, must be extended. This will need the whole time of a trained dental hygienist. The urgent need for more work on nutrition has already been referred to. Finally, extension of work for mothers and young children, as well as for the school child, must occupy much of our time in the future.

Statistical tables relative to health weeks, exhibits, literature and lectures follow: —

Exhibit at Health Weeks and Health Days.

Amesbury.	Franklin.
Ashburnham.	Greenfield.
Attleboro.	Haverhill.
Belchertown.	Ipswich.
Belmont.	Montague.
Boston.	North Attleborough.
Canton.	Southampton.
Deerfield.	South Deerfield.
Easthampton.	Taunton.

Exhibit at Agricultural Fairs.

Barnstable.	Great Barrington.
Brockton.	Pittsfield.
Charlemont.	Marshfield.
Fitchburg.	Worcester.

Lectures were given during the year on the following subjects: —

Venereal Diseases, ...	149	Oral Hygiene, ...	18
Public Health Nursing, ...	72	School Hygiene, ...	6
Communicable Diseases, ...	65	Cancer and Diseases of Adult	
Child Welfare, ...	58	Life, ...	3
Food and its Relationship to		Rural Sanitation, ...	3
Health, ...	58	Maternity Benefits, ...	2
Public Health, ...	54	Water Supplies, ...	2
Social Hygiene, ...	43		—
Personal Hygiene, ...	38	Total, ...	571

A table of lectures by months follows: —

MONTH.	Lectures.	Number Present.
1918.		
December, ...	19	6,835
1919.		
January, ...	53	8,783
February, ...	85	15,891
March, ...	100	21,704
April, ...	64	11,954
May, ...	65	11,364
June, ...	33	4,144
July, ...	25	1,685
August, ...	3	308
September, ...	14	1,479
October, ...	51	10,547
November, ...	59	9,618
Totals, ...	571	104,312

During the fiscal year ending Nov. 30, 1919, lectures were given in the following cities and towns: —

Abington, ...	1	Bridgewater, ...	5
Adams, ...	3	Brimfield, ...	1
Agawam, ...	4	Brockton, ...	3
Amesbury, ...	6	Brookline, ...	3
Amherst, ...	1	Cambridge, ...	17
Andover, ...	7	Canton, ...	7
Arlington, ...	1	Chatham, ...	1
Ashburnham, ...	7	Chelsea, ...	2
Athol, ...	3	Clinton, ...	1
Attleboro, ...	9	Cohasset, ...	1
Auburn, ...	2	Colrain, ...	1
Avon, ...	1	Concord, ...	4
Ayer, ...	3	Danvers, ...	3
Barnstable, ...	1	Deerfield, ...	10
Becket, ...	1	Dighton, ...	1
Bedford, ...	1	Douglas, ...	1
Belchertown, ...	4	Duxbury, ...	1
Belmont, ...	11	Easthampton, ...	5
Berlin, ...	1	East Longmeadow, ...	2
Boston, ...	97	Edgartown, ...	1
Bourne, ...	2	Enfield, ...	1
Boxford, ...	1	Everett, ...	3
Braintree, ...	1	Fairhaven, ...	2

Fall River, ...	4	Natick, ...	2
Falmouth, ...	2	New Bedford, ...	9
Fitchburg, ...	2	Newburyport, ...	3
Framingham, ...	2	Newton, ...	6
Franklin, ...	5	North Adams, ...	2
Freetown, ...	3	North Andover, ...	2
Gardner, ...	1	North Attleborough, ...	2
Georgetown, ...	1	Northbridge, ...	5
Gloucester, ...	7	Northfield, ...	1
Goshen, ...	1	Northampton, ...	2
Great Barrington, ...	2	Norwood, ...	1
Greenfield, ...	4	Orleans, ...	3
Grafton, ...	6	Palmer, ...	1
Harvard, ...	1	Pembroke, ...	1
Haverhill, ...	15	Pittsfield, ...	9
Hingham, ...	1	Plainfield, ...	1
Hinsdale, ...	1	Provincetown, ...	3
Holbrook, ...	3	Quincy, ...	4
Holliston, ...	1	Revere, ...	1
Holyoke, ...	7	Rockland, ...	1
Hudson, ...	2	Salem, ...	8
Hyannis, ...	10	Salisbury, ...	2
Ipswich, ...	10	Sandwich, ...	3
Kingston, ...	1	Saugus, ...	3
Lancaster, ...	2	Somerville, ...	2
Lawrence, ...	4	South Hadley, ...	3
Leominster, ...	7	Southampton, ...	4
Lowell, ...	13	Springfield, ...	11
Ludlow, ...	2	Stockbridge, ...	1
Lunenburg, ...	2	Stoneham, ...	5
Lynn, ...	5	Taunton, ...	8
Malden, ...	1	Tisbury, ...	1
Mansfield, ...	3	Townsend, ...	2
Marblehead, ...	1	Walpole, ...	1
Marlborough, ...	2	Waltham, ...	3
Marshfield, ...	1	Wareham, ...	1
Medford, ...	6	Warren, ...	2
Medway, ...	1	Watertown, ...	4
Melrose, ...	3	Wellesley, ...	2
Mendon, ...	1	Westborough, ...	2
Methuen, ...	5	Westfield, ...	4
Middleborough, ...	2	Westford, ...	1
Milford, ...	2	West Newbury, ...	3
Monson, ...	2	West Springfield, ...	1
Montague, ...	6	Wilmington, ...	3
Nahant, ...	1	Williamsburg, ...	2

Winchendon, ...	1	Ashville, N. C., ...	1
Winchester, ...	2	New Orleans, La., ...	1
Woburn, ...	2	Providence, R. I., ...	3
Worcester, ...	11	Washington, D. C., ...	1
Total, ...	565	Total, ...	571



REPORT OF THE BOARD OF STATE EXAMINERS OF PLUMBERS

JAMES C. COFFEY, *Chairman*

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REPORT OF THE STATE EXAMINERS OF PLUMBERS.

Information concerning Examinations for Plumbers, showing the Place and Date of Examination and Number examined, together with the Results of the Examination, etc.

EXAMINATIONS.	Examined.	Passed.	Refused.
Boston, Dec. 7, 1918, ...	41	5	36
Lowell, Dec. 21, 1918, ...	11	2	9
Boston, Jan. 4, 1919, ...	29	9	20
Pittsfield, Jan. 18, 1919, ...	4	3	1
Boston, Feb. 1, 1919, ...	54	13	41
Springfield, Feb. 15, 1919, ...	26	5	21
Boston, Mar. 1, 1919, ...	68	12	56
Fall River, Mar. 15, 1919, ...	18	5	13
Boston, Apr. 5, 1919, ...	70	9	61
Worcester, Apr. 26, 1919, ...	25	3	22
Boston, May 3, 1919, ...	69	9	60
Lowell, May 17, 1919, ...	6	2	4
Boston, June 7, 1919, ...	91	16	75
Pittsfield, June 21, 1919, ...	16	3	13
Boston, July 5, 1919, ...	89	14	75
Boston, Sept. 6, 1919, ...	102	9	93
Springfield, Sept. 20, 1919, ...	35	4	31
Boston, Oct. 4, 1919, ...	84	11	73
Fall River, Oct. 18, 1919, ...	17	3	14
Boston, Nov. 1, 1919, ...	58	8	50
Worcester, Nov. 15, 1919, ...	33	6	27
Totals, ...	946	151	795

	Masters.	Journeyman.	Total.
Licenses granted on account of examination Dec. 1, 1918, to Dec. 1, 1919.	45	105	150
Probationary licenses issued during year, ...	-	2	-

REGISTRATIONS.	Masters.	Journeymen.
December, 1918, ...	1	4
January, 1919, ...	5	10
February, 1919, ...	3	11
March, 1919, ...	8	14
April, 1919, ...	4	7
May, 1919, ...	6	10
June, 1919, ...	3	14
July, 1919, ...	8	11
August, 1919, ...	4	6
September, 1919, ...	0	12
October, 1919, ...	3	10
November, 1919, ...	7	16
Totals, ...	52	125

Meetings, ... 55	Examinations, ... 21
------------------------	----------------------------

FEE RECEIVED.	Paid to the Treasurer of the Common- wealth.
945 examination fees, at \$0.50, ...	\$472 50
53 master plumber licenses issued, at \$2, ...	106 00
127 journeymen plumber licenses issued, at \$0.50, ...	63 50
1,759 master plumber renewals issued, at \$0.50, ...	879 50
4,154 journeymen plumber renewals, at \$0.50, ...	2,077 00
Back fees, at \$0.50, ...	202 00
Total, ...	\$3,800 50
Interest during May, ...	1 94
Interest during June, ...	1 07
	\$3,803 51

For carrying out the Provisions of the Act relative to the Examination of Plumbers.

Salaries, ...	\$2,604 50
Examiners' wages, ...	405 00
Traveling, ...	457 88
Express, ...	40 88
Printing, ...	95 63
Postage, ...	95 00
Books and stationery, ...	71 38
Plumbers' materials, ...	8 00
Extra services, ...	426 50
Cleaning, ...	19 00
Office supplies, ...	3 98
Telephone and lighting, ...	101 07
Total, ...	\$4,328 82
Unexpended balance, ...	471 18
	\$4,800 00

Summary of Registrations.

	Masters.	Journeyman.
Certificate holders (individuals) (holding journeymen, also, 311), . .	462	461
Licenses, year ending May 1, 1919 (individuals) (holding journeymen, also, 1,539), ...	1,766	2,830
Totals, ...	2,228	3,291

Number of last master license issued up to Aug. 1, 1919, 2,761.

Number of last journeyman license issued up to Aug. 1, 1919, 6,403.

Deceased Plumbers reported to Examiners.

Masters, ... 8 | Journeyman, ... 5

Respectfully submitted,

JAMES C. COFFEY.
CHAS. R. FELTON.
DAVID CRAIG, *Clerk.*



**PAPERS WRITTEN IN 1919 AND PAMPHLETS
ISSUED**

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PAPERS WRITTEN IN 1919 AND PAMPHLETS ISSUED.

PAPERS WRITTEN BY MEMBERS OF THE STATE DEPARTMENT OF HEALTH DURING THE YEAR 1919.

Division of Administration.

Eugene R. Kelley, M.D., Commissioner of Health.

"What has More Centralized Control to Offer in Solving the Tuberculosis Problem?" Transactions of the National Tuberculosis Society, Sociological Section, Atlantic City, N. J., June, 1919.

"The Attack on the So-called Venereal Diseases." Transactions of the Conference of Charities and Corrections, Portland, Me., September, 1919.

"Open-Air Schools." Transactions of the Maine Anti-tuberculosis Society, Portland, Me., 1919.

"The State Clinics for the Treatment of Venereal Diseases." Boston Medical and Surgical Journal, Sept. 11, 1919.

Eugene R. Kelley, M.D., and Stanley H. Osborn, M.D.

"Further Evidence as to the Relative Importance of Milk Infection in the Transmission of Certain Communicable Diseases of Man." American Journal of Public Health, 1920.

Division of Sanitary Engineering.

Mr. Bertram Brewer.

"Public Control over New Streets in Relation to Extension of Water Mains." Journal of the New England Water Works Association, Vol. XXXIII, No. 4, Section 1, December, 1919.

Division of Communicable Diseases.

Bernard W. Carey, M.D.

"Lessons from a Study of 1,000 Diphtheria Deaths." Boston Medical and Surgical Journal, Jan. 16, 1919.

Bernard W. Carey, M.D., and John S. Hitchcock, M.D.

"A Median Endemic Index." American Journal of Public Health, May, 1919.

Stanley H. Osborn, M.D.

"Scarlet Fever Wave in 1919." *Boston Medical and Surgical Journal*, Dec. 4, 1919.

Division of Biologic Laboratories.

Milton J. Rosenau, M.D.

"Some Interesting though Unsuccessful Attempts to Transmit Influenza Experimentally." *United States Public Health Service Reports*, 34, No. 2, Jan. 10, 1919.

"All About Milk." Revised edition. Metropolitan Life Insurance Company, New York, 1919.

"Fallacies in the Diagnosis of 'Ptomaine' Poisoning." *Medical Clinics*, North America, March, 1919.

"'Ptomaine' Poisoning." *Journal of the American Medical Association*, March 8, 1919, p. 730.

"'Ptomaine' Poisoning." *Boston Medical and Surgical Journal*, Apr. 3, 1919, p. 398.

"Food Poisoning." *American Journal of Public Health*, September, 1919.

Wm. A. Hinton, M.D., and E. S. Kane, M.D.

"Use of Influenza Vaccine as a Prophylactic." *The Commonwealth*, April, 1919. *Journal of Tennessee State Medical Association*, 1919.

Division of Food and Drugs.

Hermann C. Lythgoe, S.B.

"Violations of Massachusetts Cold Storage Egg Laws and Method of Control." *American Food Journal*, January, 1919.

Mr. Clarence E. Marsh.

"Composition of Market Milk in Massachusetts." *Annual Report*, International Association of Dairy and Milk Inspectors, 1919.

Division of Hygiene.

Merrill E. Champion, M.D., C.P.H.

"Health Centers for Pre-school Children." *Standards of Child Welfare*, Conference Series, No. 1, Children's Bureau, United States Department of Labor, 1919.

"Maternity Benefits." *Transactions of American Child Hygiene Association*, 1919.

PAMPHLETS ISSUED BY THE STATE DEPARTMENT OF HEALTH.

- Anthrax in Massachusetts. 19 pp.
Cancer. Facts which Every Adult should know. 1920.
Diphtheria Bulletin. (Leaflet.) 1919.
The Occurrence of Infantile Paralysis in Massachusetts in 1908. 26 pp.
Infantile Paralysis in Massachusetts in 1909. 105 pp.
Infantile Paralysis in Massachusetts, 1907-12. 151 pp.
Infantile Paralysis; Committee Report; State and Provincial Boards of Health. 8 pp. 1917.
The 1916 Epidemic of Poliomyelitis. 53 pp. 1919.
Influenza Bulletin. (Leaflet.) 1918.
The Control of Ophthalmia Neonatorum. 6 pp. 1917.
The Control of Typhoid Fever. 11 pp. 1911.
Antityphoid Inoculation; Typhoid Prophylactic. 12 pp. 1912.
The Venereal Diseases. 1918. 5 pp.
Report of State Board of Health upon the Sanitary Condition of Factories, etc., 1907. 144 pp.
Sanitary Organization of Zone about the Military Camp at Ayer, Mass. 4 pp. 1917.
The Abatement of Nuisances. 7 pp. 1913.
Nuisances and Boards of Health. (Massachusetts Association of Boards of Health.) 5 pp. 1917.
Mosquitoes and Malaria. 1916. 3 pp.
Prevention of Flies. 7 pp. 1917.
Résumé of the Present Status of Medical Supervision of School Children in Massachusetts. 22 pp. 1917.
Posture and Its Relation to Health. 1919.
A Health Creed for Massachusetts Boys and Girls. (Card.) 1916.
The Baby and You. Revised edition. 1920.
Care of the Child in Hot Weather. 1918. 7 pp. (Booklet, 3 by 5 inches.)
Diet No. 1. Diet for Baby from Birth to Twelve Months. (Card.) 1918.
Diet No. 2. Diet for Child from Twelve Months to End of Second Year. (Card.) 1918.
Diet No. 3. Diet for Child from Three to Six Years. (Card.) 1918.
Food for Children from Two to Six Years Old. 15 pp. 1918.
Food for the Child. 7 pp. 1918.
Food Rules for School Children. (Card.) 1918.
Food: What it is and what it does. 7 pp. Revised edition. 1920.
Food and the Calorie. 7 pp. 1918.
Tissue-Forming Foods. 7 pp. 1918.
Fats and Their Value in the Diet. 8 pp. 1918.
Carbohydrate Foods. 8 pp. 1920.
The Importance of Minerals in the Diet. 1918.
A Few Simple Facts about Digestion. 7 pp. 1919.
Food for Working Women in Boston. 1917. 213 pp.

Report of the Special Milk Board of the Massachusetts State Department of Health. 1916. 358 pp.

List of Illustrated Lectures and Moving Pictures on Public Health Work. Revised edition. 1920.

Health Habits. 1919.

The Importance of Mouth Cleanliness. 1919.

The Home Care of the Mouth. 1919.

Do You Know That — (Mouth Hygiene.) 1920.

School Health Program. 1919.

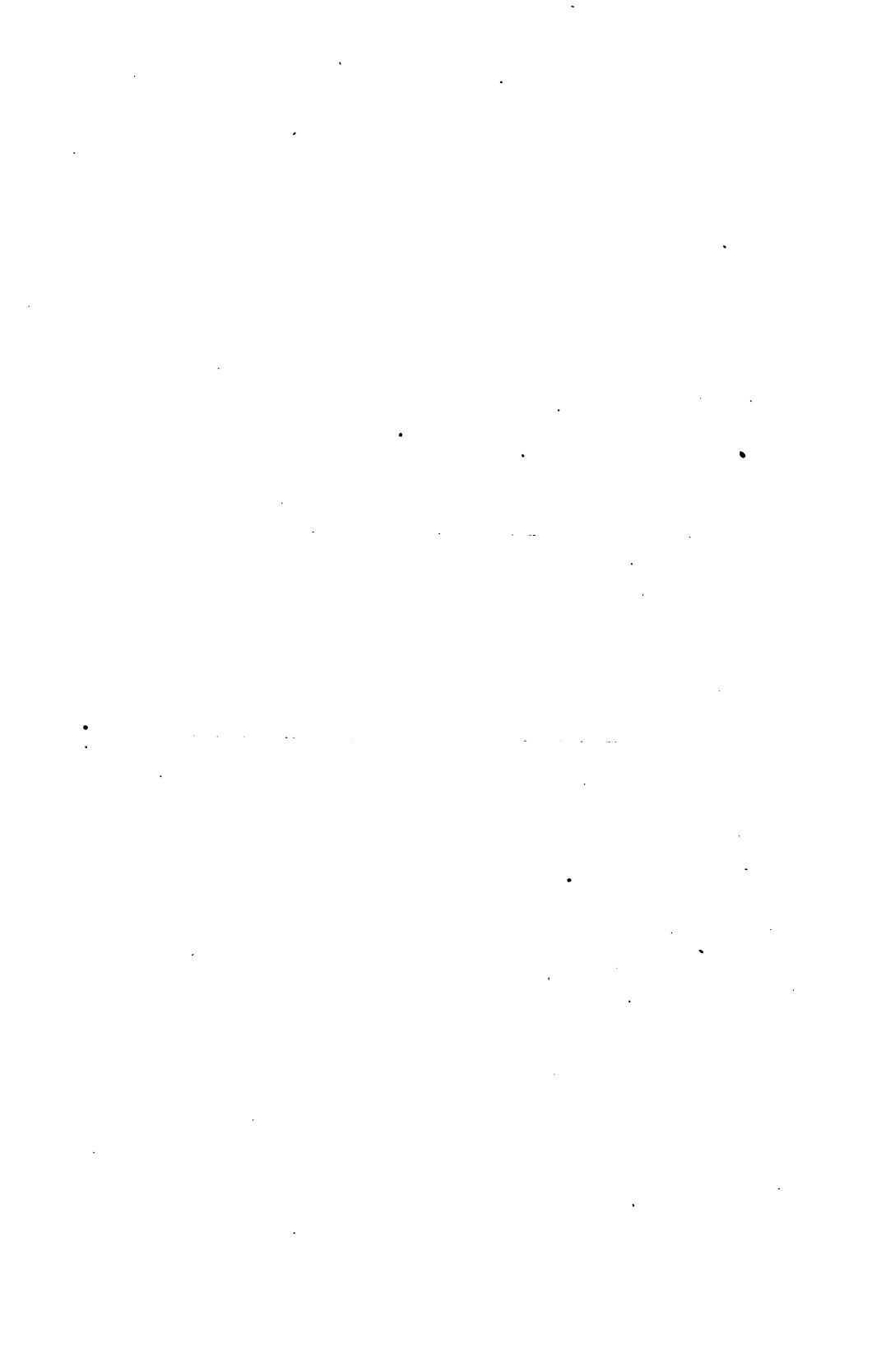
Ways in which the State Department of Health Can Aid You. 1919.

The School Lunch. 1920.

Suggested List of Books on Hygiene for the Town Library. 1920.

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